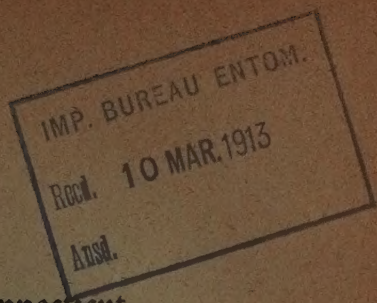




State of Connecticut

REPORT

OF

The Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

ELEVENTH REPORT OF THE STATE ENTOMOLOGIST, 1911

W. E. BRITTON, PH.D.

BEING PART IV OF THE ANNUAL REPORT OF 1911

ELEVENTH REPORT

OF THE

STATE ENTOMOLOGIST

OF

CONNECTICUT

FOR THE YEAR 1911

BY

W. E. BRITTON, PH.D.

State Entomologist

New Haven, Conn.

1912

STATE ENTOMOLOGIST

CONVICTS

FOR THE YEAR 1907

W. A. SMITH, JR.

W. A. SMITH, JR.

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ILLUSTRATIONS.

Figures 3, 7, 8, 9 and 10 are from drawings by Mr. A. B. Champlain. Figure 4 is from a drawing by W. E. Britton. Figure 5 is from a drawing by Mrs. E. L. Beutenmuller. Figures 1, 2 and 6 are maps showing infestations, prepared by Mr. B. H. Walden.

Plate I is from a photo by W. O. Filley; plate VI, 4 and 5, and plate XI, b, by W. E. Britton; plate II, b, was made directly from a colored placard drawn by A. B. Champlain; plate XVI, b, from photo by J. W. Chapman; plate IX from photo loaned by G. D. Seymour; all other plates from photos by Mr. B. H. Walden of this department.

PART IV.

ELEVENTH REPORT

OF THE

STATE ENTOMOLOGIST OF CONNECTICUT

To the Director and Board of Control of the Connecticut Agricultural Experiment Station:

I transmit herewith my eleventh annual report as State Entomologist of Connecticut.

As is the custom, the financial statement covers the state fiscal year, but otherwise the report covers the calendar year of 1911.

Respectfully submitted,

W. E. BRITTON,

State Entomologist.

REPORT OF THE RECEIPTS AND EXPENDITURES OF THE STATE ENTOMOLOGIST
FROM OCTOBER 1ST, 1910, TO SEPTEMBER 30TH, 1911.

Insect Pest Account.

RECEIPTS.

From E. H. Jenkins, Treasurer	\$3,000.00
Account of 1910, balance	1,091.96
Sale of electrotypes	1.79
	\$4,093.75

EXPENDITURES.

For Field, office and laboratory assistance:

B. H. Walden, salary	\$1,080.00
A. B. Champlain, salary	930.00
D. J. Caffrey, salary	180.82
E. B. Whittlesey, salary	364.00
Other assistance	94.15
	\$2,648.97

Printing and Illustrations	\$ 87.65
Postage	62.73
Stationery	14.03
Telegraph and telephone	1.25
Express, freight and cartage	11.08
Library	109.15
Laboratory apparatus and supplies	78.62
Office supplies	46.75
Traveling expenses	267.53
Balance, cash on hand	765.99
	\$4,093.75

Gypsy Moth Control Account.

RECEIPTS.

From E. H. Jenkins, Treasurer	\$4,000.00
Account of 1910, balance	17.95
	\$4,017.95

EXPENDITURES.

For Salary, labor, board of scouts, etc.:	
D. J. Caffrey, salary	\$ 749.18
Labor, board of scouts, etc.	2,320.05
	\$3,069.23
Printing and illustrations	257.96
Tools and supplies	207.34
Telegraph and telephone	1.68
Express, freight and cartage	16.94
Rental of storehouse	28.50
Traveling expenses	267.33
Balance, cash on hand	168.97
	\$4,017.95

Memorandum:—This account of the State Entomologist has been duly audited by the State Auditors of Public Accounts.

DEPARTMENT PUBLICATIONS.

By W. E. BRITTON.

Tenth Report of the State Entomologist (Part IX of the Station Report for 1909-10); 56 pages, 14 text figures, 8 plates; 9000 copies distributed in March, 1911.

Report of Committee on Injurious Insects; Proceedings Connecticut Pomological Society, 1911, p. 27. 4 pages.

The Leopard Moth as a Pest of Apple Nursery Stock; *Journal of Economic Entomology*, Vol. IV. p. 298, June, 1911. 1 page, 1 plate.

A Hemipterous Fisherman; *Entomological News*, Vol. XXII. p. 372, October, 1911. 1 page.

The Pyralid, *Omphalocera dentosa* Grote, a Pest of Barberry Hedges; *Journal of Economic Entomology*, Vol. IV. p. 521, December, 1911. 4 pages, 1 plate.

Vacation Notes in the Adirondacks; *Journal of Economic Entomology*, Vol. IV. p. 544, December, 1911. 2 pages.

How to Get Rid of Ants; Special Bulletin, September, 1911. 1 page. 1000 copies.

How to Get Rid of Flies; Special Bulletin, September, 1911; 2 pages. 1000 copies.

The Brown-Tail Moth; Special Bulletin. Colored placard showing and describing brown-tail moth and its injury. 3000 copies. September, 1911.

By W. E. BRITTON AND B. H. WALDEN.

Guide to the Insects of Connecticut; Bulletin 16, State Geological and Natural History Survey. Hartford, 1911.

Part I. General Introduction. 38 pages, 3 figures, 5 plates. By W. E. BRITTON.

Part II. The Euplexoptera and Orthoptera of Connecticut. 129 pages, 63 figures, 6 plates. By B. H. WALDEN.

By W. E. BRITTON AND G. P. CLINTON.

Tests of Summer Sprays on Apples and Peaches (Part VII. of Station Report of 1909-10). 35 pages, 8 plates. February, 1911. 9000 copies.

Tests of Summer Sprays on Apples and Peaches in 1910; Connecticut Farmer, Jan. 28, 1911. 1 page.

By W. E. BRITTON AND G. A. CROMIE.

The Leopard Moth; Bulletin 169 of this Station. December 1911. 24 pages, 6 figures, 8 plates. 3000 copies.

By B. H. WALDEN.

The Locust Borer; *Connecticut Farmer*, July 15, 1911.

By A. B. CHAMPLAIN.

Some Carabidæ Taken in Connecticut; *Psyche*, Vol. XVIII. p. 35, February, 1911. 2 pages.

Notes on Coleoptera from Connecticut; *Psyche*, Vol. XVIII. p. 170, October, 1911. 4 pages.

PERSONNEL OF DEPARTMENT STAFF.

W. E. BRITTON, PH.D.State and Station Entomologist.

B. H. WALDEN, B.AGR.Assistant.

DONALD J. CAFFREY, B.S.Assistant.

ALFRED B. CHAMPLAIN*Assistant.

MISS E. B. WHITTLESEYStenographer.

Mr. B. H. Walden, who has been in the department since March, 1902, has continued as general assistant and has been in charge of all work during my absence. Mr. D. J. Caffrey has remained in charge of all gypsy and brown-tail moth field work,

* Resigned September 30th.

and has also aided in the inspection of nurseries, this work coming at a time when he was not needed on the gypsy moth work just mentioned. Mr. Alfred B. Champlain, who began as assistant April 1st, 1910, resigned, to take effect September 30, 1911, to accept a new position in the Division of Economic Zoology, Harrisburg, Pa. His place has not yet been filled, but it will be necessary to obtain someone for it before the opening of next season. Mr. J. K. Lewis, a student of the Massachusetts Agricultural College, was employed from the latter part of February until September 9th, to help inspect imported stock and in the gypsy moth work at Wallingford. Local help was chiefly employed in the gypsy moth field work at both Wallingford and Stonington.

A. W. Yates of Hartford and H. W. Coley of Westport have also continued as apiary inspectors, being paid by the day.

Miss E. B. Whittlesey has continued as stenographer, working half of each day in this department. During her vacation the letters were written by Miss Ruth I. Meeker.

All of the persons mentioned have been faithful and efficient, and the success of the work is in large measure due to them.

CHIEF LINES OF WORK.

The activities of the department for the season have been directed along the lines required by law in regard to suppressing the gypsy moth at Stonington and Wallingford, and the brown-tail moth in Windham County; the inspection of apiaries and of growing nursery stock, and of orchards on request. All imported stock that can be classed as hardy trees and shrubs that could be found has been examined for pests. This work is not required by law, and there is no provision for it, but on account of the brown-tail nests found on such stock brought in from France during 1909 and 1910, it seemed necessary to continue the inspection for the protection of the state.

Much time and effort were expended in the summer spraying work in coöperation with the botanical department. This work was carried on in eleven different orchards, and about 688 apple and 231 peach trees were sprayed with various substances, mostly commercial and home-made preparations of lime and sulphur, and including several other preparations, to note the effect upon insect troubles and plant diseases, as well as upon the foliage. In gathering data to show the results of these experiments, it was

necessary to count and score 93,000 apples and 24,000 peaches. A full account of these tests will be published as Part V of this report.

Several minor experiments and studies have been carried on during the year, namely: trials of various substances applied to young pine trees to prevent damage by the weevil, *Pissodes strobi* Peck; life history studies on *Omphalocera dentosa* Gr., a moth whose larva is a pest of barberry hedges, the result of which has been published in an article in the Journal of Economic Entomology for December, 1911, page 521; a sawfly damaging a blackberry plantation near New Haven; the leopard moth and its injuries to shade trees, Bulletin 169 (also contained in this report), by W. E. Britton and G. A. Cromie, superintendent of trees in the city of New Haven.

Mr. Champlain reared four hymenopterous parasites of the genus *Pezomachus* from spiders' eggs found under stones, etc., and an undescribed Buprestid beetle of the genus *Agrilus* from galls on hop hornbeam.

In response to a request sent to this office, Mr. Walden, during his vacation in August, examined a large salt marsh area in Eastern Massachusetts, and recommended treatment to rid the locality of mosquitoes. Mr. Walden has in several cases given advice regarding, and occasionally personal supervision of, fumigation to destroy insect pests in dwellings and storehouses.

Thirty-eight orchards, gardens and greenhouses have been examined during the year and advice given regarding treatment.

The collection has been materially increased during the year by the work of members of the department staff.

The manuscript of a check-list of the insects of Connecticut, consisting of over 400 typewritten pages, prepared by W. E. Britton, has been finished and awaits publication as a bulletin of the State Geological and Natural History Survey.

Considerable time has been given to work of an educational nature, such as institute talks and exhibits at fairs.

On the station farm at Mount Carmel, purchased a year ago, about four acres were planted last spring to apples and peaches for experimental purposes, and this orchard will be used jointly by the entomological and botanical departments for testing various sprays and other kinds of treatment for insect and fungous troubles.

SUMMARY OF INSPECTION AND OFFICE WORK FOR 1911.

- 289 samples of insects received for identification.
- 54 nurseries inspected.
- 51 regular certificates granted.
- 5 parcel certificates granted.
- 38 orchards and gardens examined for insects.
- 854 boxes and packages imported nursery stock examined.
- 162 apiaries containing 1571 colonies inspected.
- 84 apiaries containing 431 colonies found infested with European foul brood and treated.
- 2672 letters written on official work.
- 66 mail and express packages sent out.
- 14 addresses made before granges, farm institutes and civic organizations.

EXHIBITS.

The entomological department furnished a part of the general exhibit made by the station at six agricultural fairs in September and October and also a two days' exhibit on the station grounds, October 27th and 28th. The places and dates of the exhibits were as follows:

Connecticut Fair, Hartford,	Sept. 4-9
Norfolk Agricultural Association, Norfolk,	Sept. 14-15
Windham County, Brooklyn,	Sept. 19-21
State Fair, Berlin,	Sept. 25-30
Danbury Fair, Danbury,	Oct. 2-7
Stafford Fair, Stafford Springs,	Oct. 10-12
Station Grounds, New Haven,	Oct. 27-28

About 1500 square feet of table space was covered by the exhibit of the entomological department, besides numerous photographs and charts hung on the walls and over the center table. Additional space was occupied at the exhibit on the station grounds, because the exhibit of another department had to be shown at Boston at the same time, and the entomological department supplied material to fill a portion of the vacant space.

The appearance of a part of the entomological exhibit is shown on Plate I. Its chief features were special exhibits of the gypsy moth and measures for controlling the pest; the brown-tail moth; foul brood disease of bees; the leopard moth; the seventeen-year locust and its distribution in Connecticut in 1911; malarial and non-malarial mosquito wrigglers; twenty or more species of living caterpillars; cases illustrating garden

insects, forest insects, shade tree insects, fruit insects; a large display of the more striking and common insects of Connecticut in all orders; many life-history sets of injurious species in Riker mounts; plaster casts of fruit, and fresh fruit attacked and injured by insects and fruit kept perfect by spraying; insecticides and spraying apparatus. All objects, cases and special exhibits were explained by uniform printed labels.

To keep labels in their proper place, supply fresh food for caterpillars, answer questions and explain the exhibits and methods of control, required the constant presence of one or more entomologists, and the preparation of the material took far more time and attention than the exhibition of it.

ENTOMOLOGICAL FEATURES OF 1911.

The weather conditions must be considered as bearing some relation to the scarcity or abundance of insect life. The season of 1911 was characterized by one of the most severe droughts ever known, and many plants, even orchards and woodland trees, were injured in various places by it, and the yield of field crops greatly diminished. Specimens of leaf scorch were sent to the station from all parts of the state. Many injurious insects, especially grasshoppers, white grubs and aphids, cause more damage in dry seasons, due in part, no doubt, to the comparative absence of certain fungous and bacterial enemies which require moisture for their development.

The green apple aphid, *A. pomi* DeG., and the rosy apple aphid, *A. sorbi* Kalt., were both more abundant than in 1910, and in some cases the latter caused a severe check to the development of the fruit. This species is especially prone to attack bearing trees, and is usually found on the fruit clusters.

Cut worms caused much damage, and there were many complaints and inquiries regarding them.

The chinch-bug, *Blissus leucopterus* Say, normally rather rare in Connecticut, seemed to be more abundant than usual, and many specimens were taken in the sweeping done in general collecting.

Canker worms were abundant locally, as they have been for many years. In fact, they do much damage somewhere each year, but do not continue to be abundant in the same locality more than three or four years. At the station grounds, where the fall

canker worm has been abundant for about four years, it is now diminishing, and probably it will be six or seven years before it again does serious damage. Apple orchards in the vicinity of Newtown and Danbury were stripped of their leaves, and the writer noticed much damage in North Haven, Wallingford and Mount Carmel. In the station orchard at Mount Carmel and in the orchards of Mr. W. W. Stevens of Northford and Mr. B. O. Jones of Centerville, where we conducted spraying tests, some damage was done before the first spraying. Mr. Walden observed them upon elm and apple trees at Middletown, and injuring apple foliage in Woodbridge. Specimens and complaints were also received from Fitchville and New Milford. Early spraying with lead arsenate, say before the middle of May, will of course prevent injury.

The maple leaf-stem sawfly, *Priophorus acericaulis* MacG., was more prevalent than for several years, not only around New Haven, but specimens of its work were received from Glastonbury, Meriden and Derby, and letters describing it, from several other localities. A brief account of the life history of this insect and the damage caused by it will be found on page 305.

The season brought to notice the great damage to the shade trees of towns and cities along the coast caused by the leopard moth, *Zeuzera pyrina* Linn. The moths, especially the males, were common around electric arc lights about July 1st, and Mr. Champlain caught several of them. The destruction of the trees was the reason for investigating this pest, and Bulletin 169 was issued in December. It gives a full account of the insect, with history and treatment, and is reproduced on page 317 of this report. Examples of this insect and its work were shown at the station grounds October 27th and 28th.

Probably the most important entomological feature of 1911 was the appearance of Brood II of the periodical cicada or seventeen-year locust. The species was scheduled to appear in Connecticut, and we were on the lookout for it. There were many exaggerated newspaper stories regarding this curious insect, but we were able to obtain fairly complete records of its distribution and occurrence, much more so probably than have ever been made of any previous occurrence of this or any other brood in the state. The insect aroused much popular interest, and a case, showing the different stages, with injury to trees, and a map showing its

distribution in the state, was exhibited at the fairs. See page 296 of this report for an account of the periodical cicada or seventeen-year locust.

Mr. Walden found an apparently new pest of cultivated blackberries in a field in Highwood near New Haven, and he made a partial study of the insect, which proved to be a sawfly of the family Lydidae. Publication is withheld until the life-history data are more complete.

Good progress was made in suppressing the gypsy moth in the state. No caterpillars were found at Stonington, and at Wallingford the number was not great. The scouts examined the northeast corner of the state during February and March, and found that the brown-tail moth had spread westward from where it was found last year, in Putnam and Thompson, into the towns of Woodstock and Pomfret, and southward into Killingly. By far the worst infestation was in the city of Putnam. We may fairly expect this insect to extend itself four or five miles further each year until the whole state is infested, but the work of the men in cutting off and burning the winter nests must necessarily check it. An account of this work is given on page 281 of this report.

Adults were reared from larvæ feeding on barberry, and proved to be a pyralid moth, *Omphalocera dentosa* Gr. This was made the subject of a brief article in the Journal of Economic Entomology, which is included in this report, page 292.

Late in September there was a swarm of the brown cotton moths, *Alabama argillacea* Hubn., in New Haven and other Connecticut towns. It seems that there was a heavy migration of the adults of this insect from the cotton fields of the South, where it was unusually abundant. A note on page 340 further explains this phenomenon.

The bud moth, *Tmetocera ocellana* Schiff., was rather abundant and caused some damage in the apple orchards on the station farm and on the farms of Mr. C. K. Andrews at Mount Carmel and Mr. W. W. Stevens of Northford, where spraying experiments were conducted. Specimens were also received from Greenwich, West Cheshire, Mystic, New Britain, East Windsor and Union, and Mr. Walden observed its work on an orchard in Woodbridge. Early spraying with lead arsenate is the remedy. An account of this insect may be found in the Report of this Station for 1909, page 353.

The spiny elm caterpillar, *Euwanessa antiopa* Linn., was probably more abundant throughout the state than since 1906. Many persons find the larvæ, and take them to be gypsy moth caterpillars, though the latter are clothed with stiff, simple hairs instead of branched spines. The spiny elm caterpillar feeds in clusters, usually on elm, poplar or willow, and is described in the Report of this Station for 1906, page 260. Specimens of the insect were received during the season from Cobalt, Manchester, Salisbury, South Willington, Botsford, Hartford, East Woodstock, Farmington, Norwalk, Mystic, New Haven and Branford.

The elm leaf beetle, *Galerucella luteola* Mull., was very abundant in cities and towns where the trees were not sprayed. The dry season was especially favorable to this insect, which is destroyed in large numbers by a fungus if moisture is abundant during the latter part of July, the pupating season. Specimens were received from New Hartford, Pine Meadow, Stamford and Noroton.

The birch bucculatrix, described in the last report (1910, p. 701), which defoliated birch trees over a large area of the state in 1910, was present in 1911, but in no instance was it as abundant or causing such complete defoliation.

The woolly maple leaf scale, *Phenacoccus acericola* King, is increasing as a pest of sugar maples in cities and towns, and in New Haven and Hartford it is now necessary to practice control measures to hold it in check.

The San José scale, *Aspidiotus perniciosus* Comst., is no longer feared by the commercial orchardists, and it seems to be on the wane in many parts of the state, especially on old trees. On young orchard and nursery trees, however, it multiplies rapidly, and Mr. F. A. Bartlett writes that 1911 seems to have been a particularly good year for the San José scale, and that trees which seemed to be nearly free last spring are now badly infested.

The white pine weevil, *Pissodes strobi* Peck, was especially prevalent during the season, and is damaging forest plantations throughout the state, though more destructive in some sections than in others. The treatment generally recommended is to cut out the leaders and either destroy them before the insects emerge or place them in a cage covered with wire gauze to permit the escape of any parasites, but not of the beetles. Some preliminary tests of various substances for the purpose of preventing infesta-

tion were made last season, and are reported on page 307 of this report. It is hoped that a careful study can be made of this insect under Connecticut conditions in the near future.

INSPECTION OF CONNECTICUT NURSERIES.

Fifty-four nursery inspections were made during the calendar year, and fifty-one regular certificates granted. Two inspections were made of each of three nurseries, one inspection in the spring and the other at the regular time in the fall.

In addition to the regular nurseries, a number of private individuals who wished to send shipments of native plants, fruit stock or ornamental shrubs into other states found that they could not do so without a certificate of inspection. In order to meet such demands, it has been our practice to examine the stock and issue a certificate to be attached to each car, box, bale or package, and applying only to the contents thereof. As a rule, there are but few cases of this sort. Five such certificates were issued in 1911.

The annual inspection of growing nursery stock was commenced September 2d, and on account of delays occasioned by stormy weather and making exhibits at the fairs, was not completed until about the middle of November. The work was done by Messrs. Walden, Champlain, Caffrey, Lewis and Britton.

Most of the nurseries were freer from San José scale even than last year, due to the care and treatment given the growing stock by the owners and managers. Though it is true that the scale is less injurious than formerly, especially on old trees, it will soon cover young trees and trees in nursery rows if they become infested and are not treated. In the larger fruit nurseries of this state it is now the general practice to spray the growing trees with a miscible oil or lime-sulphur mixture. The budsticks are fumigated or dipped in oil mixture, and in one large nursery the stocks are treated with lime-sulphur in spring before the newly-set buds start. More or less spraying is also done with Scalecide during summer to check aphids, leaf-hoppers and scale insects. Such treatment of course is expensive, but results in a cleaner and better growth of stock, little of which needs to be destroyed at inspection time, and it pays in the end.

The list of nurserymen receiving certificates in 1911, which is given below, contains more names than last year. Of the last

year's list one has dropped the nursery business, and three new ones have entered it. Two nurseries have changed hands, and are included under new names. Three regular nurseries were omitted from the list last year because the treatment prescribed by the state entomologist had not been carried out by the end of the year covered by the report. These are all reinstated. One new nursery, inspected for the first time in the spring of 1911, changed hands before the annual fall inspection and both names are included in the list. Though the list contains 48 names, there are but 47 nurseries.

LIST OF NURSERY FIRMS IN CONNECTICUT RECEIVING CERTIFICATES IN 1911.

Name of Firm.	Location.	Certificate issued.	Number of certificate.
Atwater, C. W.....	Collinsville	Sept. 26,	424
Barnes Brothers Nursery Co.....	Yalesville	Oct. 17,	434
Beattie, Wm. H.....	New Haven	Nov. 22,	462
Bowditch, J. H.....	Pomfret Center....	Sept. 29,	425
Brainard Floral & Nursery Co. .	Thompsonville....	Nov. 2,	443
Braley & Co., S. A.....	Burnside.....	Nov. 9,	453
Bretschneider, A.....	Danielson.....	Nov. 7,	450
Brooks Brothers.....	Westbrook	Dec. 5,	465
Burroughs, Thos. E.	Deep River.....	Oct. 3,	426
Burr & Co., C. R.	{ Manchester, Buck- land, Durham }	Oct. 6,	427
Chapman, C. E.	North Stonington..	Oct. 31,	441
Comstock & Lyon.....	Norwalk	Oct. 11,	431
Conine Nursery Co., F. E.....	Stratford	Oct. 6,	428
Conn. Agricultural College.....	Storrs.....	Nov. 21,	461
Conn. Agr. Experiment Station, Forest Nursery (S. N. Spring, State Forester, New Haven)...	{ New Haven, Ham- den, and Rain- bow }	Nov. 16,	459
Conway, W. B.....	New Haven	Oct. 28,	439
Cross Highway Nurseries	Westport.....	Nov. 14,	457
Dehn & Bertolf.....	Greenwich.....	Oct. 17,	433
*Doorly, C. C.....	Sound View.....	May 31,	419
Dwyer, John E.....	Manchester	Oct. 9,	429
East Rock Park Nursery (G. X. Amrhyh, Supt. of Parks).....	{ New Haven	Sept. 18,	422
Elm City Nursery Co.....	New Haven.....	Sept. 18,	421
Gardner's Nurseries (2).....	Cromwell	Nov. 4,	447
Hilliard, H. J.....	Sound View.....	Dec. 8,	466
Houston & Sons, J. R.....	Mansfield Depot..	Nov. 16,	458
Hoyt's Sons, Stephen.....	New Canaan.....	Sept. 25,	423
Hubbard & Co., Paul M.....	Bristol	Nov. 7,	451

* Succeeded by Mr. Hilliard.

Name of Firm.	Location.	Certificate issued.	Number of certificate.
Hunt & Co., W. W.....	Hartford.....	Oct. 11,	430
Kellner, H. H. (2).....	Danbury.....	Oct. 16,	432
Kelsey & Sons, David S.....	West Hartford....	Nov. 4,	448
Keney Park Nursery (G. A. Parker, Supt. of Parks).....	Hartford.....	Nov. 11,	456
Malone, Est. of Geo. W.....	New Haven.....	Nov. 29,	463
Mount Carmel Forestry and Nursery Co.....	Mt. Carmel.....	Nov. 3,	445
Munro, Charles.....	New Haven.....	Oct. 28,	438
Northeastern Forestry Co.....	Cheshire.....	Nov. 3,	444
New Haven Nurseries.....	New Haven.....	Oct. 24,	436
Phelps, J. Wesson.....	Bolton.....	Nov. 1,	442
Pierson, A. N.....	Cromwell.....	Sept. 2,	420
Platt Co., The Frank S.....	New Haven.....	Nov. 20,	460
Purinton, C. O.....	Hartford.....	Nov. 3,	446
Ryther, O. E.....	Norwich.....	Oct. 28,	440
Schleichert, F. C.....	Bridgeport.....	Dec. 1,	464
Scott, J. W.....	Hartford.....	Oct. 26,	437
Sierman, C. H.....	Hartford.....	Nov. 6,	449
Stanhope, B. P.....	{ Old Lyme (address Niantic) }	May 19,	418
Streckfus, H. P.....	Litchfield.....	Nov. 10,	455
Turner, Charles.....	Hartford.....	Oct. 21,	435
Vidbourne & Co., J.....	Hartford.....	Nov. 7,	452
Woodruff, C. V.....	Orange.....	Nov. 9,	454

INSPECTION OF IMPORTED NURSERY STOCK.

BY W. E. BRITTON AND B. H. WALDEN.

As recorded in the Reports of this Station for 1909, page 328, and 1910, page 667, several winter nests of the brown-tail moth have been brought into Connecticut on nursery stock imported from foreign countries, especially France, and had these nests not been found and destroyed it is probable that at least two infested centers in the central and western portions of the state would have become established. As no federal legislation had been enacted covering the matter, it devolved upon each state to protect its own interests by causing such stock to be inspected and the pests destroyed. Consequently, in 1911, an attempt was made to inspect all woody nursery stock coming into the state as in the two preceding years, and we asked the nursery men to coöperate by informing us promptly on the receipt of stock at their nurseries in the following circular letter:

NEW HAVEN, CONN., Jan. 19, 1911.

Dear Sir:—Two years ago thousands of nests of the Brown-tail Moth, *Euproctis chrysorrhæa* Linn., were brought into the United States on nursery stock from France, and in the absence of any system of Federal inspection, this infested stock was shipped into nearly all of the Eastern States. Fifty-two of these nests were found on stock shipped into Connecticut, out of 224 boxes and packages examined. Again last year 14 nests were found on stock shipped from France to three Connecticut nurseries, five out of 707 boxes and packages being infested. If such stock is not inspected, the Eastern nurseries will soon become infested and the business seriously injured.

I therefore request you to notify me at once of any importations received from any foreign country during the fall or winter, or of any shipments expected this spring, so that an inspection can be made. Please hold all boxes and packages without unpacking until an inspector can reach your nursery. We will examine the stock as promptly as possible after receiving notice that the goods have arrived at your nursery.

Very truly yours,

W. E. BRITTON,

State Entomologist.

NOTICES REGARDING IMPORTED STOCK.

Notices were received from the Bureau of Entomology at Washington, D. C., of the arrival of goods at port of entry in most cases. The New York State Department of Agriculture kindly notified us of several shipments, as did officials of a few other states, and in one or two cases notice was received direct from the customs officials. Some stock arrived, however, and was inspected, of which no notice was received except from the importing nurseryman. In a number of cases the notice was so incomplete or contained such errors as to make it impossible to trace the stock. These shipments were usually consigned to private parties, for planting on their own or their friend's estates, but were just as liable to bring in pests as though consigned to regular nurserymen. In several instances nurserymen in other states, on receiving large importations, reshipped certain boxes and packages, without inspecting or repacking, into Connecticut. Several notices regarding such cases were received from the New York State Department of Agriculture.

INCREASE IN IMPORTED STOCK.

The amount of nursery stock brought into this country from abroad is rapidly increasing each year, presumably because on account of cheap labor it can be grown there cheaper than here.

For many years fruit stocks for root grafting or budding have been imported and we should expect that the rarer varieties of flowering and ornamental trees and shrubs would be brought into the United States from the older countries. But all kinds of nursery stock are now being imported, even such common and easily grown species as California privet and Japanese barberry. Most of this stock imported, however, comes in small sizes, and the nurseryman grows it for one or more seasons before selling it. In addition to the regular nursery importations, thousands of Manetti rose seedlings, azaleas, Easter lilies, bay trees, lily of the valley and flowering bulbs are brought into Connecticut each year by florists not engaged in nursery business. But, as the customs officials are not conversant with the differences, they are supposed to notify the Bureau of Entomology of the arrival of all living plant material. No attempt was made in Connecticut to inspect bulbs, lily of the valley pips, or herbaceous stock.

The increase is shown by the number of boxes and parcels inspected during the past three years.

Year.	Number of boxes and parcels inspected.
1909	306
1910	707
1911	854

SOURCES OF IMPORTED NURSERY STOCK.

Holland still leads, with France second, as a source of nursery stock brought into Connecticut. Probably this holds true in about the same proportions for the Northeastern United States. There is also a large increase in stock from Belgium, England and Japan. The number of boxes, etc., examined from each country is shown below.

Country.	Number of boxes bales and parcels.
Holland	449
France	154
Japan	109
England	91
Scotland	2
Belgium	15
Ireland	14
Germany	2
Miscellaneous	18
Total	854

PESTS FOUND: A RUST ON JUNIPERS FROM JAPAN.

No brown-tail nests or gypsy moth egg-masses were found on imported stock this year, though on several trees portions of the web remained, showing that the stock had been infested and the nests removed before shipping. Gypsy moth egg-masses were found in New York and possibly some other states.

In shipments received at two Connecticut nurseries from Japan, 55 plants of *Juniperus chinensis* var. *compacta* and 49 plants of *Juniperus tachibayaku* were infested with a rust identified by Dr. Clinton, botanist of this station, as *Gymnosporangium Japonicum* Syd. This rust showed as orange-colored gelatinous pustules on the stems. It has another stage which is a well recognized and quite injurious disease of pomaceous fruit trees in Japan.

All the plants mentioned above were obviously infested, and were burned. Others of the same kinds in the same shipments were planted out and isolated from pomaceous fruit trees to be watched by Dr. Clinton, and destroyed if found diseased.

LEGISLATION.

Attempts to secure national legislation providing for the inspection of imported nursery stock have been continuous for the past fourteen years. Action has been delayed on account of a pressure of other matters, but more especially by the legislative committee of the National Nurserymen's Association, which objected to certain features of the measures proposed. A history of the whole subject would be out of place here, but various bills have been introduced, modified, rejected, or action postponed. At first it was planned to have the stock inspected at ports of entry, but this was found impracticable, and the idea was abandoned. Even this feature of federal inspection has now been dropped, and the work will probably be left for the States, even if the bill now before Congress is passed. At the meeting of the Official Horticultural Inspectors in Washington, December 28th and 29th, a conference was held with representatives of the inspectors, nurserymen, and Bureau of Entomology, and certain changes in the bill now before Congress were agreed upon, and all promised to help get action upon it. Copies of this bill as amended have not been distributed but the measure provides for a system of permits and notification that will be much more efficient than the present practice. In that respect at least it will be a benefit.

It seems almost necessary, therefore, to continue the inspection of plant material brought into Connecticut from foreign countries, though the inspection of such stock in 1911 necessitated 115 trips, and consumed time equivalent to ninety days, or the working days of nearly three and one-half months for one man. The cost of the work, including salary and traveling expenses, amounted to more than \$500.00, and some financial provision should be made by the state to cover the expenses of the work.

INSPECTION OF APIARIES IN 1911.

The law passed by the legislature in 1909 provided for the inspection of apiaries on complaint in order to suppress the bacterial diseases commonly known as "foul brood." One season's work had been done under this law, and the results published in my last report (Report of this Station for 1909-1910), page 669.

Five hundred dollars was the amount of the appropriation for this work for the period of two years, but as there was no restriction on the amount to be used each year, and as there was a demand for inspections, the money was all used in 1910. Consequently there were no funds for inspection work in 1911, and the Connecticut Beekeepers' Association introduced a resolution asking the legislature to make an increased appropriation and also to make part of it available for use in 1911. Though this resolution was somewhat changed by the committee on agriculture, to which it was referred, and the appropriation greatly reduced, the following measure was passed:

Be it enacted by the Senate and House of Representatives in General Assembly convened:

Section 1. The sum of nine hundred dollars is hereby appropriated to be paid out of any money in the treasury not otherwise appropriated, for carrying out the provisions of Chapter 185 of the public acts of 1909, concerning the suppression of contagious diseases among bees; said moneys to be available as follows: one-third thereof upon the passage of this act, one-third during the year 1912, and one-third during the year 1913.

Section 2. This act shall take effect from its passage.

Approved May 25, 1911.

Thus three hundred dollars became immediately available, and duly accredited vouchers amounting to \$299.94 were paid by the State Treasurer for the inspection work done between May 25th

and August 1st. After this appropriation for the year had been exhausted, this office received notification from the state apiary inspector of Massachusetts about some suspected apiaries near the boundary line, with a request that they be inspected. As the case seemed to be important, and as it seemed advisable to coöperate as far as possible with an adjoining state in controlling the disease, Mr. Yates was sent to make the inspections, and the costs thereof, amounting to \$23.14, were borne by this office from the general funds. The entire cost of the printed matter, inspection blanks, correspondence, and maintenance of the card index and records open to public inspection, as required by the law, are also borne by this office from its general funds, so as to leave more money for the actual work of inspecting and treating the apiaries.

Messrs. H. W. Coley of Westport and A. W. Yates of Hartford have continued as inspectors, as in 1910. Mr. Coley has jurisdiction over the four southern counties (Fairfield, New Haven, Middlesex and New London), and Mr. Yates the four northern counties (Litchfield, Hartford, Tolland and Windham) of the state.

The number of apiaries and colonies examined, and the cost of the work, are shown below:

APIARIES INSPECTED IN 1911.		
	Apiaries.	Colonies.
Number inspected	162	1571
Infested, European foul brood	84	431
Other troubles:		
Pickled Brood	8 cases	
Spring Dwindle	1 case	
Wax Moth	1 case	
Cost of Inspection, paid by state		\$299.94
" " station		23.14
Total		\$323.08
Average cost per apiary		\$1.99
Average cost per colony		.21

RESULTS OF INSPECTION AND TREATMENT.

The foul brood found in Connecticut in 1910 and 1911 has all been the European species. During 1910, 76 per cent., or over three-fourths of the apiaries, and 49 per cent., or nearly one-half of the colonies, examined were found infested. The inspection

work of 1911 shows that only 51 per cent. of the apiaries and 27 per cent. of the colonies examined were infested. Moreover, of the colonies treated for the disease in 1910 and again examined in 1911, less than one per cent. (0.8) were found diseased.

These figures show the value of the inspection work and treatment. In all cases where the disease was found, the inspectors treated the colonies by shaking upon clean frames and foundation, or showed the owners how to do it, using, of course, the proper cautions and disinfectants. The old hives were disinfected, and a few of the worst infested colonies were destroyed, but there is no need of destroying any colonies or supplies if the disease is taken in time.

The state has not as yet been well covered, almost no complaints being received from Litchfield and New London counties, and inspection can be made only on complaint. Any beekeeper, however, may sign his own complaint. It is probable that on further examination the disease will be found in all parts of the state.

In order to make the work thoroughly effective, authority should be given this office to inspect apiaries on suspicion or without waiting for complaints, especially in and around those infested centers which without treatment may continue for a long time to be distributing points for the disease. An appropriation of at least five hundred dollars per annum is needed and should not be considered unreasonable.

PROGRESS IN CONTROLLING THE GYPSY MOTH IN CONNECTICUT IN 1911.

By W. E. BRITTON AND DONALD J. CAFFREY.

The gypsy moth, *Porthetria dispar* Linn., was first discovered at Stonington in March, 1906, and a colony was found at Wallingford in December, 1909. Brief accounts of progress in exterminating the insect in each infested area will be found in each of the previous reports of this station issued since the pest was discovered. Though most of the work done was paid for out of state funds appropriated for this purpose, we wish to acknowledge the coöperation of the Bureau of Entomology in sending trained scouts to examine not only the infested areas but also much territory outside of it. The accompanying map, figure 1 on page 280, shows the location of the gypsy moth colonies in Connecticut.

STONINGTON INFESTATION.

Mr. Caffrey, with two men, began scouting for egg-masses on January 9th, 1911. Mr. Rogers furnished one scout, Mr. Miller, who also went over the same ground working part of the time by himself and some of the time with Mr. Caffrey. Mr. Miller found three fragments of egg-clusters under the edge of the lower stones of a wall near the ground a short distance from Mr. Koelb's house. All three would hardly equal one good-sized egg-mass, and may have all been deposited by one moth, perhaps disturbed in the act. It is not known whether or not these eggs were fertilized, as they were at once treated with creosote.

The summer work began May 1st, in charge of Mr. Fred Hoadley, under direction of the writers. Mr. Caffrey spent several days in Stonington in June scouting for caterpillars and inspecting the work. Three thousand five hundred trees were banded with burlap and about 100 with tanglefoot. From one to four men were employed, as needed. A number of tin patches were applied to cover cavities. The burlap bands were all removed and the work for the summer ceased on August 16th.

Though this work was carried on as in former seasons, no caterpillars could be found, and it looks as if the pest had been exterminated from Stonington. Further scouting has been done there this winter, and no egg-masses found, but the region must be examined with care next season to make sure. The statistics of the Stonington work are as follows:

RECORD OF GYPSY MOTHS DESTROYED AT STONINGTON.

Year.	Egg-masses.	Caterpillars.	Cocoons.
1906	73	10,000	47
1907	118	2,936	200
1908	76	2,560	44
1909	6	98	0
1910	1	146	1
1911	3	0	0

WALLINGFORD INFESTATION.

Mr. Caffrey, with men, started scouting work at Wallingford on November 7th, 1910. The first egg-mass was found November 14th, high up in an apple tree on South Main street. On November 22d an unusually large egg-mass was found at No. 40 Williams street. In all 23 egg clusters were found at Wallingford and the scouting work was finished on January 7th, 1911.

Work was resumed April 20th, by pruning and replacing tin patches. Tanglefoot bands were applied commencing April 25th. The first caterpillars were found on May 12th in their first stage on North Whittlesey avenue.

Commenced banding trees with burlap May 14th. First caterpillar was found under bands June 6th. Commenced turning bands June 8th. First spraying done on May 22d. On the 29th one dead caterpillar was noticed, which had been killed by the spray. On June 20th Mr. Caffrey observed many dead caterpillars killed by the poison. At this time they were from one and one-half to two inches in length.

On June 27th the first pupa, a male, was found in the breeding cage. The next day about fifty caterpillars were found in some low cherry bushes near the Whittlesey avenue dump. The brush was cut and burned at once with oil. The first pupa was found out of doors on July 6th. On July 10th the first adult, a male, emerged in the breeding cage, and the first one outside, a female, was found on July 25th.

The work on trees and turning burlap was continued until the middle of August, and a total of 1,551 caterpillars, 15 cocoons and two adults were found and destroyed, in addition to the egg-masses already mentioned, and the very large number of caterpillars killed by the poison spray and the tanglefoot bands.

The burlap bands were all removed and the summer work closed on August 17th.

Mr. Caffrey, with three men, began scouting for egg-masses November 20th, and two federal scouts began work December 6th and finished December 23d. The entire infested area was thus carefully examined by both state and federal scouts, and altogether only five egg-masses could be found.

The statistics of the year's work at Wallingford are given below:

Egg-masses destroyed	23
Caterpillars destroyed	1551
Cocoons destroyed	15
Adults destroyed	2
Trees banded with burlap	8556
Trees banded with Tanglefoot	469
Trees sprayed (not including shrubs)	116
Trees infested	216

The following figures show the number of insects destroyed since the discovery of the infestation at Wallingford:

RECORD OF GYPSY MOTHS DESTROYED AT WALLINGFORD.

Year.	Egg-masses.	Caterpillars.	Cocoons.
1910	8234	8936	96
1911	23	1551	15

The following table shows the cost of all work in Connecticut in suppressing the gypsy and brown-tail moths:

COST OF GYPSY MOTH WORK IN CONNECTICUT.

Including both Stonington and Wallingford Infestations.

Year.	State Funds.	Federal Funds.	Total per Year.
1906	\$1,500.00		\$1,500.00
1907	4,550.00	\$ 272.00	4,822.00
1908	2,550.00	77.00	2,627.00
1909	1,503.22	42.00	1,545.22
1910	4,560.22	1,411.36	5,971.58
1911	4,017.95	4,660.22	8,678.17
Total	\$18,681.39	\$6,462.58	\$25,143.97

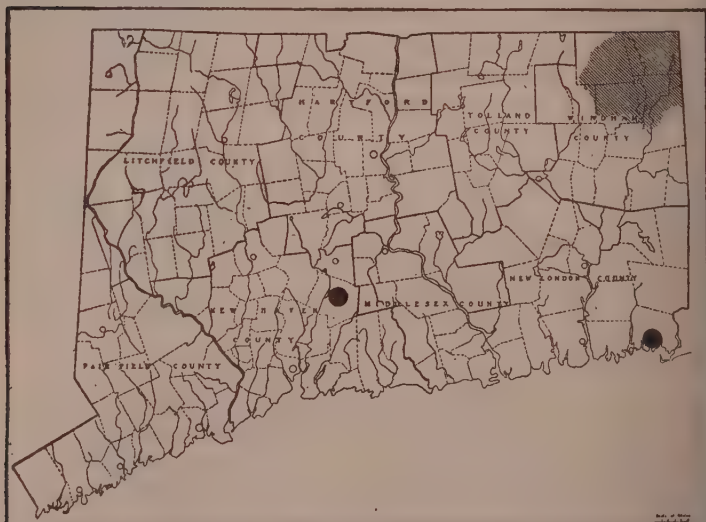


FIG. 1. Map of Connecticut. Shaded area denotes brown-tail moth infestation. Black dots show location of gypsy moth colonies.

CHECKING THE SPREAD OF THE BROWN-TAIL MOTH
IN CONNECTICUT IN 1911.

BY W. E. BRITTON AND DONALD J. CAFFREY.

The discovery of the brown-tail moth, *Euproctis chrysorrhæa* Linn., at Putnam and Thompson in the spring of 1910 was recorded in the last report of this station (see Report for 1910, page 683). At that time the trees were covered with foliage, so it was very difficult to ascertain the extent of the territory infested. However, the work of the insect was apparent through a small area in Thompson and around the center of the city in Putnam.

During the winter and early spring of 1911, from February 6th to April 20th, the towns of Thompson, Woodstock, Putnam, Pomfret and part of Killingly were scouted for the winter nests, in order to determine the limit of infestation and also to cut off and burn the nests when found. Two men were taken from Wallingford who were familiar with the work, and the local authorities at Putnam helped us by removing many of the nests from the trees in that city.

Of course it was impossible to find and remove all nests from the thick woodlands, the oaks especially, with their dead and clinging leaves, making the nests very difficult of detection; but all the open country, the orchard land and the partially wooded areas adjoining the towns and villages were effectively covered.

METHODS OF WORK.

The nests, which are nearly always at the extremities of the twigs and may be readily seen during the winter months, were removed by means of long-handled tree pruners. One of these tree pruners could be extended to a length of about twenty feet, so it was possible to remove many of the nests without getting into the trees. Many of the trees, however, especially the elms, oaks, maples and larger fruit trees, had to be climbed to get within reach of the nests, and then a twelve-foot pruner was used, as it could be handled much more easily in climbing about the tree than a longer one. Ladders were often necessary to reach the lower branches of the large trees. The use of climbing irons for this purpose should be avoided as much as possible except on

worthless trees or those with a very rough bark. When clipping off the nests, care was taken not to remove any more of the twig than necessary, and after being clipped, the nests were placed in a thick paper bag, which, with its contents, was burned at the close of each day's work. When only a few nests were found, they were wrapped in paper and burned in an ordinary stove, but generally a furnace was available when larger quantities of the nests were taken.

When examining orchards for nests, our practice was to have each man walk in the aisle between two rows of trees, looking through the branches to his left and right. The man in the next aisle does the same, and in this way each tree in every row is examined very quickly, as the nests are very easily discovered by a man familiar with his work. When the trees were in irregular clumps or standing alone, each man looked over the branches on one tree, going completely around it, and then passed on to the next tree. In all cases when looking over trees, the sky is used as a background if possible, which makes the nests more easily seen. The white silk connecting the nest with the branch is very conspicuous, and helps to distinguish the brown-tail moth nest from those of other insects.

The great majority of the nests were found on fruit trees, although some were found on elm, maple, oak, sycamore, cherry, hawthorn, birch and syringa. The extent of the area infested by the brown-tail moth is shown on the accompanying map, figure 1, page 280.

From July 4th to July 18th, when the adults were flying, Mr. D. M. Rogers stationed two men at Putnam to examine all trains headed westward or southward to remove the adult brown-tail moths, and 75 adults in trains and around the station were thus destroyed.

An account of the work in each town follows:

THOMPSON.

In the town of Thompson the nests were very scattering, being mostly confined to the western half of the town and along the Massachusetts state line. Along the Rhode Island state line but very few nests were found. The greatest number were in Thompson village and immediate vicinity, 47 nests being discovered at this point. During the previous May some spraying

had been done to control the pest on the N. B. Ream place in the village (see Report for 1910, page 684), and but for this fact the number of nests would have been larger. At Grosvenordale six nests were found; at North Grosvenordale, ten nests; in East Thompson, which is in the extreme northeastern corner of the town and of the state, only four nests; Wilsonville, three nests; Quinebaug and New Boston, eighteen nests, and West Thompson, five nests. Others were scattering between these villages, except in the eastern and southeastern part of the town, where only two scattered nests were found. A total of 112 nests were destroyed in the entire town.

PUTNAM.

The city of Putnam was quite badly infested, nearly every tree in the city having one or more nests. Some of the trees were badly defoliated the previous summer, and many of the inhabitants were afflicted with the "brown-tail rash" caused by the poisonous and irritating hairs which break off from the caterpillars and adults.

In the early part of the winter Mr. J. H. Osgood, the local tree warden, had removed about 4,000 nests from some of the worst infested trees in the center of the city, as far as his time and the funds at his command would permit. This saved us much labor.

The remaining trees in the township were examined, and it was found that the heaviest of the infestation was confined to the city limits, with a few nests outside. Some of the trees in the city yards were treated first, and at 139 Elm street five apple trees had 201 nests on them, while at 131 Elm street a pear tree had 64 and a syringa 27 nests. Just west from the railroad station, near the John O. Fox Lumber Company, four apple trees in one yard contained 431 nests, of which one large apple tree had 145 and another 125 nests. In this same yard 91 nests were taken from a large elm tree, which required much climbing, as they were on the tips of the highest branches. At East Putnam two nests were found, and at Putnam Heights three nests. In the eastern and southern parts of the town the nests were very scattering, one being taken a half-mile from the state line, and three others at a distance of about two miles from the line. In the western and southern parts they were found up to the town line. In the

entire town of Putnam a total of 5,989 nests were destroyed, including those reported by Mr. Osgood.

WOODSTOCK.

In Woodstock the infestation was largely confined to the apple orchards in the eastern and southern parts of the town, some of which were quite extensive, and much time was required to inspect them. In South Woodstock many of the orchards were badly infested, and 882 nests were found in this village and vicinity. The worst infestation in this region was on the property of Mr. Harrington, near the town line of Pomfret, where a total of 681 nests were cut from twenty-five apple trees, one large tree alone containing 166 nests. The trees surrounding this section, however, were only slightly infested. At Harrisville the nests were scattered over a large territory. At Woodstock Center 43 nests were found, at East Woodstock 27 were reported, and at North Woodstock only six were found in the village itself, but scattering nests were taken in the surrounding country. In the western half of the town the nests were few and far between, five being found in West Woodstock, with two others in surrounding territory. None were reported from Woodstock Valley or the extreme northwestern part of the town; but at Kenyonville, in the southwest corner of the town, one nest was found on an apple tree near the barn of a milkman who each day had been driving to and from South Woodstock. In the entire town of Woodstock 937 nests were destroyed.

POMFRET.

The nests were very scattering in Pomfret, with the exception of one or two orchards near Pomfret Center, where fifty of them were found, and in the northeastern corner, in territory adjoining Putnam. The nursery of J. H. Bowditch was given especial attention, but no nests were found there. At Pomfret Landing, in the southeastern part of the town, five nests were reported, at Pomfret Station two nests, at Utley Hill two nests, and one at Ragged Hill, in the extreme northwestern part of the town. Nothing was reported from Abington or Elliotts', or along the southern border of the town. In the town of Pomfret 89 nests were destroyed.

KILLINGLY.

Only the northern half of Killingly, including the borough of Danielson, was examined for brown-tail nests. This territory appeared to be the edge of the infestation in Connecticut, only six nests being found in this town, of which one was taken at East Killingly, one at Killingly Center, one at Break Neck Hill, one near the northern town line of Putnam, and one at Mashentuck Hill. The entire borough of Danielson was given a very careful examination, and one nest was found in the northern part, near Elmville.

COLORED PLACARDS ISSUED.

A colored placard 11 x 14 inches in size and containing illustrations of the brown-tail moth and information regarding it was issued in September, 1911, as a special bulletin of the station, and printed in an edition of 3,000 copies. A copy was sent to each library, each grange hall and railroad station in Connecticut. The New York, New Haven and Hartford and the Central Vermont railroad companies kindly consented to coöperate with this office by not only allowing these placards to be placed in their stations, but by issuing orders to their agents to post them. A halftone reproduction of this placard may be seen on Plate II, *b*.

SUMMARY.

The result of the work in this section shows that the brown-tail moth, in the course of its natural spread from the adjoining infested area in Massachusetts and Rhode Island, has established itself in the towns of Thompson, Woodstock, Putnam, Pomfret and part of Killingly in Connecticut. A total of 7,133 nests were found and destroyed in these infested towns, of which 112 were in Thompson, 937 in Woodstock, 5,989 in Putnam, 89 in Pomfret and six in Killingly.

Though it will be impossible to eradicate the brown-tail moth, as can be done with isolated colonies of the gypsy moth, the former can be more readily controlled, and by careful work prevented from doing any serious damage.

Colored placards were issued giving illustrations and information regarding the insect, and the cards were posted in public places such as libraries, railroad stations and grange halls throughout the state.

The previously infested towns will be scouted again this winter, and all nests found will be destroyed. It is also planned to examine the surrounding towns and those along the boundary lines of Massachusetts and Rhode Island, to determine any further spread of the insect.

THE ONION MAGGOT (*Phorbia ceparum* Meigen).

BY DONALD J. CAFFREY.

INTRODUCTION.

The name "onion maggot" is applied to the small white maggot or grub attacking the bulb or root of the onion plant and belonging to the genus *Phorbia* (*Pegomyia*) of the Dipterous family Anthomyiidae. It is well named the onion maggot for it seems never to have been recorded on any other food plant.* Economically it is very important, ranking with the cabbage maggot and seed corn maggot as a destructive pest to the growers of vegetable root crops.

The onion maggot was first described by Meigen in 1830, but its ravages had been noticed and recorded in Europe long before that time, and it had been known and widely distributed as a serious pest of onions from time immemorial.

In the United States it has been present for many years, probably being introduced from Europe in some shipment of its food. Records are present showing the pest to be very destructive throughout the Eastern and Middle States in 1854 and again in 1863. Its distribution in this country is now widespread.

In Connecticut the onion maggot has frequently been reported as doing considerable damage, and many inquiries are sent to the station concerning it. At Greens Farms, Southport, and around New Haven in 1904 it was very abundant and caused much injury to the onion crop, killing from one-fourth to one-third of the plants in large fields.

CHARACTER OF THE DAMAGE.

The presence of the onion maggot is first shown by the plants changing to a yellowish color and finally wilting, while the lower or outer sheaf of the surrounding plants has also become affected

* Slingerland, N. Y. (Cornell) Agr. Expt. Sta., Bull. 78, p. 496, 1894.

in the same manner. The leaves of these plants have become soft and flaccid to the touch, and in general have a sickly appearance. Examination will show that the cylindrical root of the young plant has been nearly cut asunder, so that only the outer epidermal tissue or shell remains. Inside of this remaining tissue one or more maggots may be found feeding. If the plant is more advanced and the bulb partly formed, a hole may be found bored either in the side or on the bottom of the onion, and one maggot is present in the interior. More commonly, however, several maggots of different sizes are found in a large irregular cavity in the center, and the earth around the orifice is wet and slimy, forming a large muddy mass, into which the maggots crawl to rest when not feeding. If the onion bulb has been infested for a longer period, it may be found soft and putrid except the lower part, which, being nourished by the fibrous rootlets, remains sound. The larger worms looking for fresh food will crawl into this remaining part to feed, so that sometimes a thronged mass of worms may be found at this point. In the recent attacks recorded from Connecticut, the highest and driest portions of the field seemed to be preferred by the pest, and in such places the first signs of infestation will probably be found.*

LIFE HISTORY.

The adult fly passes the winter in the pupa stage in the ground, and emerges with the first warm days of spring, when the plants are usually just above ground. From two to six and sometimes more eggs are laid singly on particular plants here and there through the field. According to Fitch,† the adults seem to prefer certain plants to the exclusion of others. The eggs are loosely placed on the plant above the surface of the ground between the sheath or collar and in the crevices between the leaves, and are perceptible to the naked eye. The eggs hatch in a week or ten days, varying with the temperature.

After hatching, the young maggot or larva burrows its way down inside the sheath until it reaches the root, leaving a discolored streak to mark its progress, and begins feeding upon the interior of the root. Later, when the bulb is formed, the entrance

* Britton, Rept. Conn. Expt. Sta., p. 214, 1904.

† Fitch, Rept. on Noxious Insects of New York, XI, p. 487.

may be made from the side or bottom, and several maggots may be found in the interior of each. The maggot attains full growth in about two weeks, and pupates generally in the surrounding ground, although it has been known to pupate within the onion. The pupa stage lasts about a fortnight, and then the adult fly emerges to lay eggs for another brood.

There are several broods each season, varying with the locality and weather conditions. The last brood of larvæ pass the winter in the pupa stage, and adults emerge in the spring.

DESCRIPTION.

Eggs. Laid singly and are perceptible to naked eye. White and smooth in appearance and elongated-oval in form. Size, .04 inch long and .01 inch broad.

Larva or Maggot. Glossy, dull white and smooth in appearance, of an elongate-conical form, tapering to a point at its head or forward end. When crawling and elongated, nearly the whole length of the body becomes tapering. At the extreme forward end the jaws appear as two black hooks, and show through the skin as a short black stripe. Near the head are seen the breathing organs, and the alimentary vessel appears as a stripe along the middle of the back. Hinder end of body is cut off obliquely, and on its flat surface are two small elevated brown points or spiracles, and on the margin are eight small tooth-like projections, of which the lower two are larger, while slightly in advance of these are two small processes which aid the maggot in crawling.

Pupa. In pupation, as is the case in most dipterous families, the skin of the larva hardens and changes to a chestnut-brown color, with a stain of black at each end, to form the pupa-case or puparium, inside of which the true pupa is found. This true pupa is a short, white body, showing a jointed abdomen, and with the wings and legs of the future fly appressed to its surface.

Adult. Resembles the common house fly, though smaller and more distinctly gray in color. Male, ash-colored, with black bristles and hairs and a white face. Three dark lines run along the body between the wings, while particularly noticeable is a row of long black spots along the middle of the abdomen. Female, more ochreous or ashy gray in color, with a yellowish white face. The row of long black spots along the middle of abdomen is not as distinct as in the male. Shown on Plate VIII, *e*.

The sexes are recognized by the eyes, which in the male are close together and large enough to occupy nearly all of the head, while in the female the eyes are smaller and farther apart.

NATURAL ENEMIES.

One species of golden-eyed flies of the genus *Chrysopa** has been found in great numbers in infested fields destroying many eggs of the onion maggot.

Several species of predaceous beetles have been observed feeding upon maggots in the field, the most important being a small staphylinid beetle. Minute parasitic wasps and predatory mites have been found infesting eggs in great numbers.

None of these natural enemies, however, do enough to lessen the numbers of the pest from year to year, as they confine their operations largely to individuals, and cannot be relied upon to relieve the grower from active work against the maggot.

CONTROL METHODS.

The onion maggot has proved to be a very difficult pest to control after it has once gained a firm foothold. Therefore methods of prevention must be largely relied upon to forestall damage, and to this end the following practices are recommended.

By clean culture, prevent as many insects as possible from reaching maturity and multiplying. Clean out sheds and other outbuildings, and burn the rubbish out of doors. Remove previously infested plants carefully, and burn them, to destroy all maggots that may be feeding in the roots, this step being of great importance. All crop remnants, such as root cuttings, and all wild or volunteer plants about the place should also be burned. Having made the land as clean and free from infestation as possible, plant on ground not infested the previous season and as far as possible from any land that has been infested, as the flies are not known to migrate very far to lay their eggs. Then regulate the time of planting so that the adult, which emerges with the first warm days of spring, will have laid its eggs before the main crop of plants appear. When feasible, an earlier trap crop may be planted, which after becoming infested may be carefully

* Fitch, Rept. on Noxious Insects of New York, XI, p. 493.

removed and destroyed. Planting in hills seems to be of value, as the maggots find it difficult to work their way from one infested hill to another. Fertilize well with some quick acting mineral fertilizer, avoiding stable manure, rotted leaves, or other organic fertilizers, as they are apt to induce infestation. In addition, protect the plants and prevent the eggs from being laid about them or the maggots from getting to the roots, by applying some material or covering on the surface of the ground around the stem of the plant, for which purpose the following substances are used:

PREVENTIVES.

Sand and Kerosene. A cupful of kerosene to a bucket of sand applied to the base of the plants along the rows, to prevent the parent flies from depositing their eggs. This will also kill young maggots attempting to work through it.

Carbolized Lime. Three pints of lime slaked to a thin cream, in a gallon of water with a tablespoonful of *crude* carbolic acid, applied around the plant has proved very successful.

Glue and Bran. A mixture of 2 lbs. of glue, one gallon of water and $\frac{1}{2}$ lb. of bran placed tightly around the plant prevents the young maggot from getting into the tissue beneath after it hatches.

Mineral Fertilizers. Kainit, nitrate of soda and sulphate or chloride of potash are useful as deterrents, especially when used just before or just after the ground has been wet. They may be used as a top dressing before planting, or applied afterwards as near as possible to the roots, the earth being turned away for this purpose. These fertilizers also stimulate plant growth, helping the plant to recover from maggot injury.

Other substances used frequently as repellents are powdered charcoal, powdered white hellebore, powdered tobacco, dry lime, dry unleached wood ashes, and pulverized gas lime. Salt between the rows has proven of value in some cases. Any of these preventives for best results must be applied early, and immediately after plants are set or have made their appearance above ground.

REMEDIES.

If the maggots succeed in getting a foothold, the infested plants should be taken up carefully, providing they are few in

number, and their maggot contents destroyed. If this fails to stop the infestation, other means may be tried.

Carbolic Acid Emulsion. Add to 1 lb. of soap boiled in 1 gallon of water, $\frac{1}{2}$ gallon of *crude* carbolic acid, and dilute the whole with 50 parts of water. This is perhaps the best of the remedies for general use, as it is a strong killing agent and is also said to act as a preventive. It is used to best advantage a day or two after plants are started, and should be repeated every week or ten days until the last of May in the North.

Paraffine Oil and Sand. Spread broadcast among the onions and then water the plants. It has been found very efficient in many cases as a killing agent.

Lime and Liquid Manure. Five lbs. of fresh burned lime slaked in 100 gallons of liquid manure, stirred ten minutes and applied with a sprinkler is of value, although the use of organic manures generally is not recommended.

Carbon Disulphide. Injected around the roots this is efficient in some soils, but is not practicable on a large scale.

Hellebore Decoction. Applied as soon as eggs are noticed and continued at intervals of five or six days.

Kerosene Oil sprayed upon the soil is of some value.

Hen Manure which has been covered with soil to retain ammonia is reported to be useful.

Stress is laid upon the fact that differences in soil, condition and composition make a difference in the relative efficiency of any treatment, either remedial or preventive. It should also be borne in mind that the more maggots destroyed each year the less will remain to propagate for the coming year, so that if active measures are used for two or three years the infestation will be so reduced that keeping the pest in check becomes a comparatively easy task.

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THE PYRALID (*Omphalocera dentosa* Grote), A PEST OF BARBERRY HEDGES.*

On August 12th, 1908, Dr. F. P. Gulliver of Norwich, Conn., sent to the station some curious black and white caterpillars which were feeding upon the leaves of common barberry, *Berberis vulgaris* Linn. This plant, though introduced from Europe, has become naturalized in New England and is far more common in Connecticut than the native species *B. canadensis* Pursh. The writer was away on a vacation, and his assistant, Mr. Walden, who was in charge of the department, not recognizing the caterpillars, wrote to Dr. Gulliver asking him to send more material, which he kindly did. The writer examined the caterpillars on his return September 1st, but they were entirely unfamiliar to him. In his experience of fourteen years in the state he had not at that time ever seen the species before. A few specimens were inflated, and the others placed in the breeding cages for the purpose of rearing the adults, but none were obtained. The following season the insect was not observed by anyone connected with this office.

In 1910, however, this insect was more abundant than previously, and a number of caterpillars were found feeding not only upon the common barberry, *B. vulgaris* and its purple-leaved form, but also on the Japanese barberry, *B. Thunbergii* D. C., which is

* This paper was printed in the Journal of Economic Entomology, Vol. IV, page 521, December, 1911.

used rather extensively for hedges, though not as commonly as California privet, and on another species of barberry. Enough material was secured in 1910 to enable us to rear the adults, and both sexes were obtained. See note in last Report, page 711, 1910.

During the annual task of inspecting nurseries the work of this insect was observed in 1910, especially about New Haven, and in 1911 its work was again noticed.

HABITS AND INJURY.

The adults emerged in the insectary from April 10th to 20th, but they do not appear in the open until about the first of July. On July 3d, 1911, specimens were collected by the writer on the screen door of his house, the moths having been attracted by the light in the hall. As there is a low hedge of Japanese barberry in front of the house and only a few feet away, they were doubtless there for the purpose of ovipositing, and later a few caterpillars were found on this hedge.

The writer and his assistants hunted for the eggs, but could not find them. Presumably they are laid on the leaves of the food plant. The writer's hedge was slightly attacked in both 1910 and 1911. In one instance a tall hedge of *B. vulgaris* near the writer's home was almost entirely stripped of leaves at the top for a distance of two or three rods, leaving only the old webs containing the excrement, and rendering the hedge very unsightly. Spraying with lead arsenate would, of course, be the remedy.

The larva spins a web in which is collected the excrement, giving to the web a brown or dark grey color. This forms a case in which the larva lives and feeds. It is usually about two inches long and from three-eighths to one-half inch in thickness, though varying greatly in size and sometimes being several inches long. The case is attached to the leaves or twigs of the barberry and often includes both, as well as the fruit. As the eggs are laid about July 1st, it is usually a month later before larvæ or nests are noticed, and often two months later before they are conspicuous. After the leaves drop the old nests or webs disfigure the plants throughout the winter unless removed. The larvæ do not pupate in the nests, but go into the ground and transform in a tough cell, oval or oblong in shape and made of particles of soil held together by silk threads.

IDENTITY AND LITERATURE.

On account of the appearance and characteristic position of this moth when at rest with wings folded, as well as the antennal tufts of the male, it was thought to be a Deltoid, and specimens were sent for identification to Professor J. B. Smith, who kindly replied as follows:

"Yours of the 5th inst. came duly to hand, and so did the box of specimens. The latter proved to be not Deltoids or Noctuids at all!—they belong to one of the Pyralid families, and the species is *Omphalocera dentosa*. I am under the impression that this species was described and figured in one of the Government publications, but have no note on the subject, and can't be sure at the present time. I know that nothing much has been written concerning the species."

In searching the more accessible works for the literature of the species, only two references could be found. One of these was the original description which is included in this article, and the other a brief note by Dr. H. G. Dyar in an article entitled, "A Review of the North American Pyralinae" (Proceedings Entomological Society of Washington, Vol. X, p. 101, 1908), giving records as follows:

"Omphalocera dentosa Grote.

"New Haven, Conn. (A. H. Verrill); Plummer's Island, Maryland, June 6, 1902 (H. S. Barber); Ames, Iowa, June 6, 1896 (C. P. Gillette); Black Jack Springs, Texas (Wm. Barnes); Dallas, Texas, May 31, 1896 (Dept. Agr., No. 6351), larvæ on *Berberis*. I have also a female from Durango, Colorado, that is less vinous in tone and more darkly colored, perhaps a distinct species, but with the present material I do not venture to separate it.

"Larvæ received from Mr. A. H. Verrill, which I think belong to this species, are black with many white dots, without the red lines of *cariosa*."

Dr. H. T. Fernald has also kindly examined the card index in his office and consulted his father's catalogue, and assures me that no other references occur there.

As the literature seems to be scanty, this brief article is submitted for publication in the hope that it may be of help to other workers who may collect or observe the caterpillars on barberry.

DESCRIPTION.

Adult. The species was described from a female specimen by Grote, in Bull. U. S. Geological and Geographical Survey of the Territories, Vol. VI, No. 2, p. 272, as follows:

"Omphalocera dentosa n. s.

♀ A little larger than *cariosa*, with quite a different color, being dusty olive brown, without any reddish brown tinges. The median space is dark blackish brown. The pattern of ornamentation is the same, but the outer line is composed of well-defined and rather broad, open teeth. The line is double, filled in by a pale shade, and is brought a little nearer the margin over the median nervules than in *cariosa*. The interspaces beyond the t. p. line show dentiform shadings of the lighter and darker colors of the wing. The fringes are dark. The terminal dots do not contrast as much as in *cariosa*. The veins are darker marked. *O. dentosa* has the under surface fuscous with a common external double line near the border, which seems a little less strongly dentate than in *cariosa*. The abdomen is furnished with brown tufts on the dorsum in both forms. In place of the discal mark (?) there is a pale dot on the subcostal vein and one below it on median vein, quite distinct in *cariosa*, hardly evident in *dentosa*, which expands 40 mil."

I have not been able to find any description of the male, and take it to be undescribed, but in the specimens reared it closely resembles the female in color and markings. The median space is smaller and less well-defined, the markings are slightly less distinct, and it is smaller in size. Both sexes have the dark brown or black tufts on the dorsum of the abdomen, and the male has the brown antennal tufts and the longer anal tufts which are sexual characters.

The specimens reared are somewhat more of a reddish brown tint than one would expect from Grote's description, yet there is a distinct olive tint on the basal two-thirds of the secondaries.

Larva. Length, about one and one-half inches, thickness about three-sixteenths of an inch; somewhat flattened and thicker laterally than vertically. Ground color black dorsally, brown ventrally. Marked dorsally and laterally by small white irregular-shaped spots arranged rather irregularly as follows:—Two transverse rows on each segment as seen dorsally; three longitudinal rows as seen in lateral view, one nearly in line with the spiracles, one above and one below, these being in addition to the transverse dorsal rows of spots. Sometimes a fourth longitudinal row may be made out below the other three and at the base of

the legs and pro-legs. Head dark brown or black, sculptured or pitted and shining; marked with white patches more or less irregular in shape, the arrangement not entirely symmetrical. Legs black and shining, with white patches on the first and second basal joints. Head and body sparsely covered with nearly straight light and dark hairs of medium length.

The larvæ, adults and nests are shown on Plate III. Credit is due to my assistants, Messrs. B. H. Walden and A. B. Champ-lain, to the former for making the photographs and to the latter for the drawing of the larva. Also to Professors J. B. Smith and H. T. Fernald for the courtesies already mentioned.

THE PERIODICAL CICADA OR SEVENTEEN-YEAR LOCUST IN CONNECTICUT IN 1911.

Brood No. II of the periodical cicada or seventeen-year locust, *Tibicen septendecim* Linn., was scheduled to appear in the central portion of Connecticut in 1911, so we were on the watch for it. The station collection contains examples of this brood collected in Branford in 1894, by Dr. W. C. Sturgis, then botanist of this station. But in 1894 no attempt was made to obtain records or to study the distribution of the insect in the state. In 1903, Brood XI was expected, and though we made many observations and inquiries, we did not obtain a single record.

Consequently, 1911 seemed to afford an excellent opportunity to collect data, and in addition to the observations made by the office force, much information was gathered from other sources. On June 1st, five hundred return postal cards were issued to fruit growers, entomologists, and others, particular care being taken to include at least two observers in every town in the state. The following request was sent out on the return postal cards:

OFFICE OF STATE ENTOMOLOGIST.

AGRICULTURAL EXPERIMENT STATION.

NEW HAVEN, CONN.

Dear Sir:

June 1, 1911.

In a few days the seventeen-year locust or periodical cicada (Brood II) is due to emerge from the ground in Connecticut, where it has appeared every seventeen years since 1724. Though not of great economic importance, on account of its peculiar life history this insect is of great interest, and this office seeks records of distribution in the state.

Will you therefore kindly fill out the attached return post card, giving any notes regarding the presence or absence of this insect in your locality this year? Please return this information on or before July 1st.

Thanking you in advance, I remain,

Very truly yours,

W. E. BRITTON,
State Entomologist.

The results of the postal card canvass are as follows:

Return postal card requests issued	500
Cards returned	134
Failed to report	366
Reports of insects being present	47
Reports of insects not present	87
Number of counties infested	3
Number of towns infested	21
Number of towns not infested	58
Number of towns not reported'	89

A number of additional reports were received from correspondents and acquaintances who had made observations at one or more points in the state. From all the data gathered, it is evident that Brood II of the periodical cicada appeared in 1911 in the same localities as in previous cicada years. It was present in the following counties and towns:

Hartford County: Avon, Berlin, Farmington, New Britain, Plainville, Rocky Hill, Southington, West Hartford.

New Haven County: Branford, Cheshire, East Haven, Guilford, Hamden, Meriden, New Haven, North Branford, North Haven, Wallingford.

Middlesex County: Cromwell, Durham, Killingworth, Middlefield, Middletown.

The area occupied by Brood II in Connecticut in 1911 is shown on the accompanying map, figure 2, on page 298.

ABUNDANCE IN PARTICULAR LOCALITIES.

Though the shaded portion of the map indicates the area where the adult cicadas were found, it should be understood that they by no means occupied the whole of this area. As a rule, they occupy high ground, and do not breed on the lower levels. They were especially abundant on some, though not all, of the dry wooded trap rock ridges, and here their song or rattling noise

could be heard for a long distance. In some of the areas, intervening, however, the cicadas are seldom if ever seen. For instance, none were found on the station grounds and only a few were noticed on the station farm at Mount Carmel, but on the ridge west of the farm the noise at times was almost deafening. One observer described the noise as being "like a great many mowing machines going at once."

In the following localities they were particularly abundant: West Rock and the ridge toward the north; Mt. Carmel and

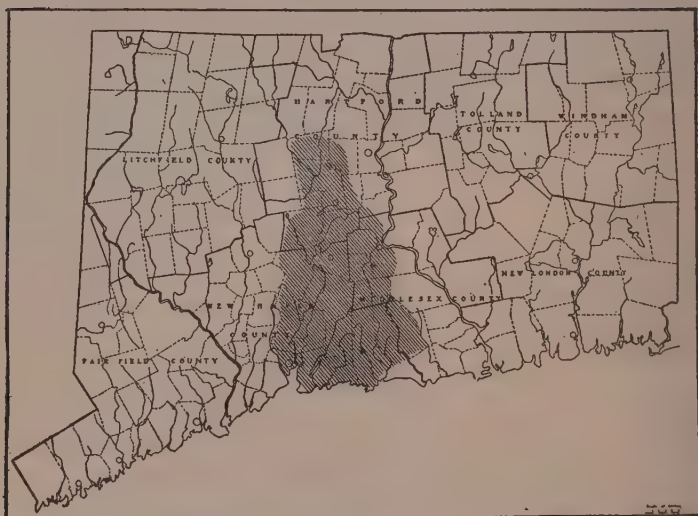


FIG. 2. Map of Connecticut showing area occupied by Brood II of the periodical cicada in 1911.

the ridge northward; Hanging Hills and vicinity, Meriden; Shuttle Meadow district, Southington; Rattlesnake Mountain, Farmington; Talcott Mountain, West Hartford; Lamentation Mountain, Rocky Hill; East Meriden; Middlefield; East Wallingford; Wallingford; North Haven; and Guilford.

Mr. E. C. Warner, who has a farm and orchards in the town of North Haven near Clintonville, reported on June 10th that the cicadas were very abundant in one of his peach orchards on the north side of a piece of woodland, and that he counted 136 pupa skins on one tree. On June 27th he reported that much

injury had been done by the ovipositing, causing the branches to break and the leaves to wither and turn brown. Similar conditions existed also in the peach orchards of F. H. Benton, Z. P. Beach, W. A. Henry & Son, and C. O. Young, Wallingford; J. T. Molumphy, Berlin; C. N. Burnham, C. E. Lyman, Middlefield; R. Wilcox & Sons, Guilford; and H. F. Baumgardt, Hamden.

Ovipositing occurred in the woodland generally, and the broken branches dried up, giving the trees a brown appearance as if scorched by fire. In some of these thickly infested areas the cicadas were much more abundant than seventeen years ago, while in other localities they were less abundant. Mr. Willis I. Savage of Berlin stated as follows: "The ground in a neighboring orchard that was uncultivated was covered with them, so that they could be picked up by the quart. They seem to be in larger numbers than seventeen years ago." Mr. E. Rogers of the Shuttle Meadow district, Southington, wrote: "There are more than there were seventeen years ago." Mr. Marcus Cooke of Wallingford says: "More are seen here than seventeen years ago." Mr. J. Norris Barnes of Yalesville wrote: "These insects are present in the woods in the locality of the old Hough and Barnes orchard site, where seventeen years ago they were very abundant." On the other hand, Mr. S. G. Cooke of Branford states: "Not as many as thirty-four years ago, when they did great damage in my apple orchard. When they appeared seventeen years ago, I gave them a good dose of Paris green mixed with ashes while they were helpless, which killed most of them. Very few there this year." A friend who observed the cicadas in 1894 told me that the trees on the east slope of Saltonstall Ridge in East Haven were brown on the northern part of the ridge, but that the limits of injury reached only about half its length, and was sharply defined, the southern half of the ridge being green. As no such appearance could be noticed in 1911, or important injury detected in the locality, it is fair to assume that the cicadas were scarce there, or at least much less abundant than seventeen years ago.

DATE OF APPEARANCE.

The first account that came to my notice regarding the presence of the cicada's was from a Southington correspondent, published in a New Haven newspaper of April 29th, 1911, stating that

workmen on the farm of Benjamin Parkin plowed up countless numbers of the pupæ. The records of first emergence of the adults, so far as reported, are as follows: Farmington, May 12th, A. B. Cook; Unionville, June 4th, A. A. Moses; Avon, June 4th, J. W. Alsop; New Britain, about June 1st, D. N. Camp; Elmwood, June 3d, F. H. Stadtmueller; Berlin, May 28th, W. I. Savage; Rocky Hill, June 3d, Miss M. J. Harris; Middletown, June 2d, F. E. Boardman; Durham, May 28th, H. J. Nettleton; Killingworth, June 7th, Mrs. M. I. S. Evarts; Wallingford, about May 25th, A. T. Henry, May 31st, G. A. Hopson, June 1st, C. D. Hall, June 2d, M. A. Cooke; Branford, June 2d, S. G. Cooke. The cicadas were thickest about the middle of June, and then began to decrease in numbers, and soon after July 1st they had disappeared.

DAMAGE TO TREES.

Though the pupæ come out of the ground and crawl upon the trunks, branches and foliage of trees and shrubs, and the adults emerge, leaving the old shells hanging there, they produce no appreciable injury to the trees except the splintering of the twigs caused by the females in laying their eggs. Several correspondents wrote to this office that the cicadas were eating up their trees. But as the adults are sucking insects, they could at most only suck out a little of the sap, and could not devour any of the tissues. In laying eggs, however, by means of the sharp, tough and horny parts of the ovipositor, the female is able to puncture the hard wood and lay eggs in it. The ovipositor consists of three spear-shaped pieces or blades, the lateral ones having serrated edges for cutting. These pieces slide lengthwise upon each other, and are very effective in mutilating the twigs.

The eggs are laid in longitudinal rows of punctures along the under side of the twigs of the previous season's growth, having a diameter of between one-fourth and one-half inch. Where there are many punctures in a twig it is often so weakened that it breaks in the wind, and though sometimes falling to the ground, it usually hangs, and the leaves dry and turn brown. There is damage to the trees, no doubt, from the effects of great numbers of the larvæ sucking at the roots, but this injury is difficult to observe or estimate, and probably is usually attributed to other causes.

The greatest damage noticed by the writer was where peach trees had been used for egg-laying. The weight of the fruit caused the twigs to break and hang down, and the fruit as well as the leaves withered. In portions of the orchards mentioned nearly all the fruit was destroyed. Some twigs had five or six peaches each, and broke very readily from their own weight. Nearly all hung, however, until the wood became dry and brittle before separating entirely from the tree. In addition to the loss of the crop for the season, about a season's wood growth was destroyed, leaving little or no chance for the formation of fruit buds for the following year. On apple and other fruit trees the results were similar, though apparently much less serious than with peach trees.

On rapid growing trees the scars soon heal, but on trees making a slow growth they do not heal for several years. Ordinarily, however, there is little or no permanent injury to the tree, and soon after the insects disappear the orchardist thinks little about them. The accounts of serious injury which one reads in newspapers are generally based upon the imagination or upon other causes, and are not the verdict of men who have given careful study to the subject. The appearance of the splintered twigs is shown on Plate V, *b*.

HABITS AND LIFE HISTORY.

Some six or seven weeks after the eggs are laid in the twigs, the young cicadas hatch from them, drop to the ground, and work their way into it, going twelve or eighteen inches beneath the surface. Here they live a subterranean life for seventeen years, where it is difficult to follow their movements and development. Yet this has been done in three or four cases by the Bureau of Entomology, and it was found that the larvæ molted four times, the fourth molt usually occurring about the tenth year. They burrow chiefly with their forelegs, suck the juices from the small roots from one-eighth to three-sixteenths of an inch in diameter, and upon such food they subsist for the full period of seventeen years, when the pupæ crawl out of the ground, leaving round exit holes about three-eighths of an inch in diameter. Sometimes these holes are very close together, and in several instances came out of the middle of a private road, where the ground was very hard and solid. Earlier records of Brood II

show that in some cases the pupæ make cones or huts by raising the soil up around their burrows to a height of two or three inches. None of these were observed in Connecticut in 1911.

The pupa crawls up the trunks of trees or upon the twigs or leaves, the stems of weeds, or upon buildings and fences, and soon the skin splits along its back and the adult cicada emerges, at first a greenish white, limp, soft body. It remains near, clinging to the surface with wings hanging downward, and soon hardens and assumes its normal appearance. Within a week or so after emerging from the shell the adults have mated and the female has begun to lay eggs. As all do not emerge at the same time, some adults may be found for a period of about six weeks.

The old shells remain upon the trunks and branches for a long time. I counted nearly a hundred on the trunk of one tree in Wallingford, and Mr. Warner counted 136 on one tree in North Haven.

The rattling noise is made entirely by the males, which have curious sound boxes or drums on the under side of the body just back of the legs at the base of the abdomen.

DESCRIPTION.

Egg. About 2 mm. long, white or pale yellow, transparent, slender, curved and pointed at both ends.

Larva. Dirty white, light brown or yellowish color. A wingless grub, with forelegs modified for burrowing, and with sucking mouth; resembling pupa. More or less hairy.

Pupa. About one inch long, nearly three-eighths inch thick, light brown or tan in color, with prominent legs, the fore pair fitted for burrowing. Head and eyes prominent, antennæ relatively small and inconspicuous. Abdomen large. Thorax and abdomen smooth and shiny. Head and legs hairy.

Adult. Wingspread of about three inches. Body from one to one and one-fourth inches long, about three-eighths of an inch thick. Wings transparent, shiny. Costa bright orange-yellow, other veins fuscous shading to orange at base of wings. Margins and marginal cells more or less fuscous-shaded, the shading and venation at base of marginal cells forming a W near the apex of each forewing. Body dark brown or black above, waxy. Ventral surface of body and legs brown shading to orange. Eyes bright coral red in life, color mostly disappearing in death.

Antennæ filamentous, inconspicuous, tapering, 6-jointed, black. The female has a sharp-pointed abdomen with a horny ovipositor folded up on the ventral surface near the tip. The male has a larger and more blunt abdomen, with a pair of sound boxes or drums on the under side at the base, just back of the rear legs.

The appearance of the adults and pupal shells may be seen on Plates IV and V, and in figure 3.



FIG. 3. Periodical cicada, adults and pupa shell on leaf. Natural size.

NATURAL ENEMIES.

No parasites were reared from cicada eggs in Connecticut in 1911, though four species of dipterous (two-winged flies) larvæ are known to feed upon them in the United States. Four species of hymenopterous (four-winged flies) insects are known to parasitize the eggs, though only one of these, *Lathromeris cicadæ* How., is at all abundant. This has been found sufficiently abundant in some parts of the country to considerably check the periodical cicada. Several species of mites are also known to feed upon cicada eggs.

This insect has predaceous enemies, one of the most important of which is the large digger wasp or cicada killer, *Sphecius speciosus* Dru., which stings the adult cicada and carries it away to its underground nest to serve as food for the young wasps. The sting paralyzes but does not kill the cicada, and the wasp lays an egg on the body of the cicada, upon which the young wasp larva feeds. No doubt predaceous ground beetles devour some of the newly hatched young, as well as the emerging pupæ.

It is probably true that birds devour large numbers of cicadas. Hundreds of cicada wings were seen on the ground in many places

in Wallingford, Guilford and other towns, and Mr. Orrin Gilbert observed similar conditions at Middletown. Marlatt mentions* the investigations of Mr. A. W. Butler, who found thirty-one species of birds that fed upon the periodical cicada in South-eastern Indiana in 1885. The most important of these were the English sparrow, and among native birds, the robin, blackbird, catbird, red-headed woodpecker, flicker, towhee, and orchard oriole. In the list of less important cicada enemies we find the thrushes, Baltimore oriole, several sparrows and fly catchers, and the crow. We made no observations on the subject in this state, but it seems to be recognized by at least some of the farmers of Connecticut that crows feed upon cicadas. From two different sources, Berlin and Middletown, the reports stated that crows do not bother corn when cicadas are present in abundance.

A fungus described in 1851 as *Massospora cicadina* by Peck destroys many adults, especially males, in some parts of the country. This appears on their bodies as a greenish mold, but was not observed on cicadas in Connecticut in 1911.

PREVENTIVE MEASURES.

It is hardly practicable to enforce any measures for the destruction of the larvæ or pupæ in their subterranean chambers, except in a restricted way on private grounds and over small areas. Carbon disulphide injected into holes twelve inches deep, one for each square yard, the holes closed, will undoubtedly prove fatal to the larvæ.

The pupæ and adults may be gathered by hand and destroyed for the protection of choice trees or shrubs on private grounds. Mr. Abner Hoopes of West Chester, Pa.,† had a field of nursery stock containing some 240,000 peach trees near the edge of woodland infested by Brood X in 1902. Seven men were employed for over two weeks, and by actual count these men each destroyed more than 1,000 cicadas every day, or a total of about 100,000 altogether. Nevertheless, in spite of this work, Mr. Hoopes lost 12,000 out of the 240,000 trees from the attacks of the cicadas.

Small and choice specimen trees may be saved from injury by covering them with mosquito netting.

* Bureau of Entomology, Bull. 71, p. 138. 1907.

† Entomological News, Vol. XVIII, p. 108. 1907.

The newly emerged adults may be easily destroyed by dusting with fresh insect powder or pyrethrum in the early morning, while the dew is on them. Spraying with kerosene emulsion seems to be fairly satisfactory in destroying the adults, especially if diluted not more than five or six times.

Various repellent substances have been tried from time to time, and Slingerland* found some evidence that ordinary whitewash will partially prevent them from ovipositing, especially if there are untreated trees near at hand. Alwood† observed that where orchard trees were sprayed with Bordeaux mixture they were injured considerably less than those untreated. Though we have no real evidence, it seems probable that a spray of dilute lime-sulphur, such as is now used on the foliage for summer spraying, might be even more effective as a repellent than Bordeaux mixture.

For a more detailed account of the periodical cicada or seventeen-year locust the reader should consult Bulletin No. 71, Bureau of Entomology, U. S. Department of Agriculture, by Dr. C. L. Marlatt, a publication from which the writer has drawn freely in preparing this paper. It contains a series of maps showing the distribution of each brood, and also gives a complete bibliography regarding this insect, up to the time of its publication in 1907.

Descriptions of other kinds of cicadas occurring in Connecticut may be found in Entomological News, Vol. XVIII, p. 16, 1907.

THE MAPLE LEAF-STEM BORER.

Priophorus acericaulis MacG.

The life history of this insect was first discovered in 1906, and published in Entomological News, Vol. XVII, page 313, and mentioned in the report of this station for that year, page 295, and it was again rather common in 1911. Specimens of its work were received on May 25th from Brookfield Center and from Glastonbury, on May 31st from Meriden, and on June 1st from Derby. It was also noticed in New Haven, Wallingford, and several other towns by entomologists from this office. Apparently it was more

* Bureau of Entomology, Bull. 71, p. 143. 1907.

† Bureau of Entomology, Bull. 40, p. 75. 1903.

abundant in 1911 than it has been since 1906. The insect is one of the sawflies, and was first described by Dr. A. D. MacGillivray from material sent him from this office, in *Canadian Entomologist*, Vol. XXXVIII, page 306, September, 1906. As no adequate account of the species or illustrations of its work have ever appeared in the station publications, this brief article is included here in hope that the illustrations on Plate VI may enable someone to recognize the trouble.

CHARACTERISTIC INJURY.

The petioles or stems of the leaves are tunneled by the larvæ, and break off at a point half to quarter of an inch from the blades. The blades fall late in May and early in June, often covering the ground, while the stems or petioles remain upon the tree until ten days or two weeks later, when they are shed and drop to the ground. Property owners not understanding the trouble are greatly alarmed, and fear that the tree will lose all of its leaves. In the very worst cases that have come to my notice, however, not more than one-third of the leaves dropped. If there is a storm about June 1st, often a large number of leaves are taken off in one or two days.

LIFE HISTORY AND HABITS.

The egg is laid on the stem at the base of the leaf-blade about the first week in May, though probably oviposition extends over two or three weeks. There is no record regarding the time necessary for the eggs to hatch. The larvæ tunnel in the stems for about a month, often eating out the inside completely, and leaving only a cylinder of epidermis closely packed with castings. The stem thus keeps its shape, or perhaps is somewhat swollen, but it has no strength. The epidermal tissue is usually eaten nearly through when the larva approaches maturity, about three weeks after hatching, and the stem breaks off at this point. The greater portion of the stem hangs upon the tree for a week or ten days, ripens at the base as it would in autumn, and drops to the ground. The larva emerges from the stem through a hole in the side and goes into the ground three or more inches, and pupates in an earthen cell resembling the cell of the common currant worm, a closely allied species. The adult emerges the following May, and is a small four-winged fly with transparent

wings, black antennæ, head and thorax, and with honey-yellow abdomen and legs.

The egg is colorless, about 1 mm. long and five times as long as thick, falcate or curved, with ends blunt and rounded. The full-grown larva is about one-third of an inch long and one-sixteenth of an inch in thickness, light yellow, with dark yellow or light brown head. Egg and larva are shown in figure 4.

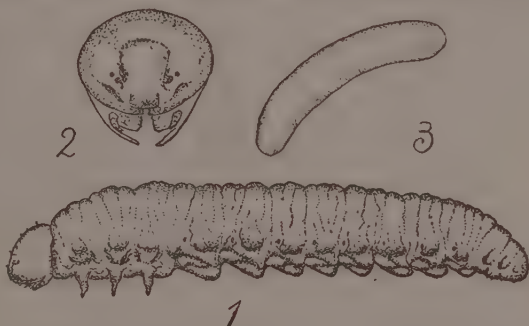


FIGURE 4. Maple leaf-stem borer. 1, full-grown larva; 2, head of same; 3, egg. All greatly enlarged.

NATURAL CHECKS AND REMEDIES.

A single example of a chalcidid parasite, still undetermined, but resembling *Pteromalus*, was reared from the material in the breeding cages.

No experiments have been made with remedies, but as it took seven years to finally obtain the adults of this species, it is evidently not hard to destroy. The knowledge of its life history indicates that if the ground under the infested trees be cultivated, or sprayed with kerosene emulsion about June 15th, when the larvæ are going into the ground, a large proportion of them will be destroyed.

RECORD OF PRELIMINARY TESTS TO PREVENT DAMAGE BY THE WHITE PINE WEEVIL.

BY W. E. BRITTON AND B. H. WALDEN.

The white pine weevil, *Pissodes strobi* Peck, is the most serious insect pest of young white pines in Connecticut. This insect has been present in the state for many years, but its injury has greatly increased during the past few seasons, owing to the fact

that the white pine is being extensively planted as a forest tree. The larva of the weevil bores in the terminal shoot or leader of the past season's growth, usually killing it in one season, thus checking the tree for one year. If this was the extent of the injury, one of the lateral branches would gradually assume an upright position, taking the place of the leader, but this in turn is often killed by the weevil, so that in a few seasons the tree is but a stunted bush.

The common practice has been to cut out and burn the leaders containing the larvæ as soon as the injury is noticed. As the adult weevils pass the winter in the ground and come out about the first of May and feed upon the leaders for a few days before depositing eggs in them, treating the leaders either to poison or repel the adults was suggested. Extensive experiments in this direction were prevented by other work, but a few preliminary tests were made in a small field owned by Mr. E. Kent Hubbard of Middletown. The trees were eight to ten feet high, and had been injured seriously by the weevil in previous seasons. The applications were made May 17th, probably after some eggs had been laid as a number of adults were present at this time. Mr. Wickson, the superintendent, observed a pair of adults on May 13th, and treated a number of trees on that date. The materials used and the results are given in the following table:

Materials used.	No. trees treated.	No. trees losing leaders.	Remarks.
Paste lead arsenate,* 4 lbs. in 50 gallons water, $1\frac{1}{4}$ oz. per gal.	9	1	No injury from treatment.
Paste lead arsenate, 4 ozs. in 1 gallon water.....	11	3	No injury from treatment.
Commercial lime and sulphur, 1 pint in 1 gallon water.....	3	0	No injury from treatment.
"One for All," 8 ozs. in 1 gallon water.....	8	0	Nearly all leaders treated showed injury.
Whale-oil Soap, 8 ozs. in 1 gallon water.....	8	1	No injury from treatment.
Tree Tanglefoot.....	3	1	No injury from treatment.
Checks.....	10	6	

* This treatment made by Mr. Wickson May 13th. All other treatments made May 17th.

The applications should have been made about May 1st, or perhaps earlier in certain seasons. The lead arsenate applied May 13th appeared to give better results than the stronger mixture (at the rate of 12 lbs. in 50 gallons) applied five days later. Though these experiments are not extensive enough to form any definite conclusions, they indicate that considerable injury from the weevil can be prevented by spraying the leaders with lead arsenate at the proper time. Trees up to four or five feet high could be sprayed with a good knapsack pump at a small cost.

There were not enough trees sprayed with lime and sulphur to form any conclusions. It would simply act as a repellent, and must be tested further to note its value, also to watch the effect on the trees; yet in this case not even the pine leaves were injured by the mixture, which was of the same strength as is commonly used on dormant fruit trees to kill San José scale. Whale-oil soap is more expensive to use than the materials above mentioned. Tree Tanglefoot is impracticable on account of the difficulty in applying it, and on account of injury "One for All" of the composition and proportions used must be abandoned, though the manufacturer claims that its composition has been changed so that no injury now follows its use.

THE CHERRY TENT-MAKER OR CHERRY TORTRIX.

Archips cerasivorana Fitch.

This insect was first described by Fitch in his third report on the noxious insects of New York, page 382, but seems to have been seldom mentioned in literature. As it attacks chiefly the choke cherry, it can scarcely be considered as an injurious insect, and this may explain the small number of references. Nevertheless, the nests are very conspicuous, and may be seen by any observer. For this reason a note regarding it is included here.

According to Weed,* the eggs are laid in summer in flattened masses on the bark of choke cherry bushes near the ground. Though at first yellow, the egg-cluster soon turns dark brown, and is almost indistinguishable from the bark except on close inspection. These eggs do not hatch until the following spring, when the larvæ crawl to the top of the bush and there construct their nest or tent, which is generally cone-shaped, being largest

* Bureau of Entomology, Bull. 26, n. s., p. 33. 1900.

at the base near the ground, and tapering upwards until it reaches a sharp point at the top. The entire bush is enveloped and the branches drawn together and fastened by the web, inside of which the caterpillars feed. An illustration from the U. S. Department of Agriculture, used in Smith's Economic Entomology, figure 371, shows between fifteen and twenty of these tents close together, and some of them apparently as high as a man's head. Usually they are less abundant, but may be seen singly or in clusters of a few nests each in clumps of choke cherry bushes along the roadsides or hedgerows. Specimens were received in 1911 from Roxbury and Milford. There is but one brood each year.

Though the choke cherry is the principal food plant, it also feeds upon the garden cherry and upon birch, especially *Betula populifolia*. Kellicott* stated that in 1882 this insect was "too abundant in certain ornamental birches in Buffalo." Spraying with lead arsenate would, of course, prevent damage.

The caterpillar is reddish brown in color, about one and one-fourth inches in length, and with a dark brown shiny head.

The adult moth has a wingspread of about an inch. Forewings reddish brown, with darker brown patches. Secondary wings and under surface lighter reddish brown. Adult, larva, pupa and nest are shown on Plate VII.

THE POPLAR MOCHA-STONE MOTH OR TENT-MAKER.

Melalopha (Ichthyura) inclusa Hubn.

A note in last year's report, page 710, mentions the prevalence of this insect, which also continued to be abundant in 1911. The caterpillars feed gregariously upon the different kinds of poplars and willows, and make small webs which remain on the twigs and resemble the winter nests of the brown-tail moth. The caterpillars do not remain in the nests, however, through the winter, like the brown-tail caterpillars. They rest in them while feeding, but pupate in September or early October. The empty webs hang to the twigs after the leaves fall, and are frequently mistaken for brown-tail nests.

* Fifth Report U. S. Ent. Commission, p. 505. 1890.

Evidently there are two generations annually, as the larvæ are found during May and June and during August and September, and the adults appear in March and may be taken during April and May, and again in July and August. The loosely spun cocoons may be found between partially folded leaves on the ground. Ordinarily this insect is not sufficiently abundant to cause much damage, and when it does appear in numbers, spraying the trees with lead arsenate is a satisfactory remedy.

The fully matured caterpillar is about one and one-half inches long and between three-sixteenths and one-fourth inch in thickness, body nearly cylindrical, with first and second and eleventh and twelfth segments tapering. Color dark brown or black, with four narrow dorsal lines honey-yellow in color; three similar lines show laterally above the spiracles, and below them the entire body color, including prolegs, is honey-yellow, excepting the true legs, which are black. Head black, somewhat shining, covered with soft hairs. On each of the fourth and eleventh segments there is a closely set pair of high, pointed tubercles, dark brown in color, bearing hairs. Body more or less thickly covered with soft curved hairs, white and light brown in color.

The adult moth has a wingspread of about one and one-fourth inches, color light brownish gray, with apical third of wings darkened with reddish brown or fawn and marked with fine white lines. Head dark brown, and a patch of the same color upon the thorax has margins extending in convergent lines to a point at the base of the secondaries.

Both larva and adult moth are shown on Plate VII, *a*. This insect is also called the poplar defoliator and the poplar prominent.

THE COLORADO POTATO BEETLE.

Leptinotarsa decemlineata Say.

BY B. H. WALDEN.

The Colorado potato beetle or "potato bug," as it is often wrongly called, is probably one of the best known insects in the state, but as many inquiries are being received about it as well as for literature regarding it, the following account is given.

The Colorado potato beetle, as the name suggests, is supposed to be a native of Colorado, where it was first observed feeding

upon one of the nightshades common in that region. Through the introduction of the potato by the western settlers, the beetle found a food plant preferable to the native nightshade, and began to spread eastward over the sections in which potatoes were then grown. The insect was described in 1824 by Thomas Say, but did not begin to attract attention as a pest of potatoes until about 1865, when the insect had crossed the Mississippi river in its eastward journey. The potato beetle reached the Atlantic coast about 1872-73. The spread of the insect had been so rapid that in 1876 it covered about one-third of the United States, and methods of treatment were discussed at a meeting of the Connecticut Board of Agriculture held during that year.*

The insect is too well known to need detailed description. The adults, which are of a yellowish color with ten longitudinal black stripes on the wing covers, pass the winter in the ground and emerge early in the spring, often before the potato plants appear above ground. The beetle feeds for a few days, when the female lays a number of masses of orange-colored eggs, usually on the underside of the leaves. The eggs hatch, depending upon the temperature, in 4-10 days. The larvæ or "slugs" become full-grown in about 16 days to 3 weeks and then go into the ground to pupate. The adults of the second brood begin to appear in about two weeks. There are two broods each season. The egg-laying period may extend considerably over a month, so that the insect is found in all stages nearly all summer, and the adult beetles often cause as much injury as the larvæ.

Other cultivated plants often seriously injured by the Colorado potato beetle are egg plants, tomatoes, tobacco and occasionally peppers. It feeds readily on any of the wild solanaceous plants, and in the absence of these has been known to attack cabbage, thistle and mullen.

Remedies. It is interesting to note that the Colorado potato beetle was the first insect against which an arsenical poison was used. In small fields the beetle can be kept in check by jarring the adults into a pan of kerosene, and picking off any egg-masses at the same time. Large fields are treated with arsenical poisons. Paris green was one of the first poisons employed for this purpose, and is extensively used at the present time. It can be

* Conn. State Board Agriculture Report for 1876, pp. 263-268.

applied dry while the dew is on the plants by means of a powder gun at the rate of about one pound to the acre. The objection to this method is that many of the powder guns cannot be accurately adjusted to evenly distribute so small a quantity of material, and many of the plants will be burned by an excess of Paris green, while others will not receive sufficient poison to be effectual. A better method is to mix the Paris green with 10-20 parts of cheap flour, sifted land plaster or air-slaked lime before applying. It is always advisable to add lime (air-slaked) to neutralize the soluble acid usually contained in Paris green, and if this is done no injury will result. Large plants can be much more thoroughly treated by spraying. The Paris green should be used at the rate of one pound in 100 gallons of water to which two pounds of fresh slaked lime has been added. It can be combined with Bordeaux mixture, which is used to control blight, without the addition of the extra lime.

Lead arsenate is replacing Paris green in spraying potatoes as in all other spraying with arsenicals. The paste lead arsenate should be used at the rate of three pounds in 50 gallons of water, or the dry lead arsenate at the rate of $1\frac{1}{2}$ pounds in 50 gallons of water. The lead arsenate is less liable to injure foliage, sticks to the leaves much better than Paris green, and one application is often as effectual as two or more of the latter.

Poison should be applied as soon as the young larvæ begin to hatch, and the number of applications to be given will depend upon the abundance of the pest as the season advances.

Often only an occasional plant will be infested at first and with a small amount of poison in a compressed air knapsack sprayer one can treat these in a short time. Frequently this will reduce the numbers so that no further treatment will be necessary.

Dr. J. B. Smith of New Jersey recommends spraying potatoes as soon as the beetles begin to feed in order to kill these before the eggs are laid.

Attention is called to the following articles for a more complete account of the Colorado potato beetle:

The Colorado Potato Beetle. Report of New Jersey Agr. Expt. Station, pp. 452-458. 1895.

The Colorado Potato Beetle. Circular No. 87, Bureau of Entomology, U. S. Dept. Agr. 1907.

THE PEACH SAWFLY IN CONNECTICUT IN 1911.

By B. H. WALDEN.

The peach sawfly, *Pamphilius persicum* MacG., which was discovered in the state in 1906 and found to be not only a new enemy of the peach but an undescribed species, was discussed in the Seventh Report of the State Entomologist.*

In the orchard of Barnes Brothers at Yalesville, which was sprayed in 1907, the treatment was so successful that the insect has not again appeared in sufficient numbers to require further treatment, but it has spread gradually to other orchards, and is now well distributed throughout the central and eastern part of New Haven county, is present in the western portion of Middlesex county, and probably extends into the southern part of Hartford county. In 1910 considerable injury was reported in the orchards of Barnes Brothers at Durham and in the orchards of Charles E. Lyman at Middlefield, although as far as we learned no peach trees were sprayed during that season to control this insect. The peach sawfly also stripped many small trees in the orchard of J. A. Martin, Wallingford, in 1910, and on June 9th, 1911, the writer visited this orchard by request to learn if the insects were abundant enough to cause serious injury later. The owner stated that the adult flies were very abundant during the previous week. At the date of the visit there were very few adults present. There were, however, many hymenopterous insects (unidentified) flying about the trees which might be mistaken for the sawflies. These may have been parasites of the above pest. Eggs of the sawfly were present in a large section of the bearing orchard, and were more numerous, four to five on a leaf, in the two-year trees that were defoliated the previous season. The owner was advised to spray the young trees the following week with lead arsenate and also that part of the bearing orchard where the eggs were the most numerous, and to watch the remainder of the orchard and to spray if there was any indication of the trees being defoliated. The owner sprayed the trees as advised, including many more of the bearing trees. In all between eight thousand and ten thousand trees were sprayed

* Report Conn. Agr. Expt. Station, pp. 285-300, Pl. I-VI. 1907-08.

with lead arsenate, two lbs. to 50 gallons of water, to which was added $1\frac{1}{2}$ quarts commercial lime-sulphur. No injury was reported to the foliage and the sawfly was held in check. Several isolated trees not sprayed were badly eaten.

In the Durham orchards of Barnes Brothers about 20,000 peach trees were sprayed with lead arsenate, using three lbs. in 50 gallons of water. Many of the trees were badly injured by the spray, and some trees that were given, as considered by the men, "an extra good treatment," dropped nearly all their leaves. The lead arsenate was a standard brand guaranteed to contain 15 per cent. arsenic oxide. One and one-half pounds of the lead arsenate would probably have been sufficient to kill the sawfly larvæ, as insects of this class are very readily killed. The lead arsenate used in spraying 6,000 peach trees without injury in 1907 contained less than 12 per cent. of arsenic oxide. Whether the higher percentage of arsenic oxide in the lead arsenate used in 1911 was responsible for the injury or whether the injury was due to soluble arsenic or to weather conditions, we are unable to state. The indications are that this brand of lead arsenate contained an excess of soluble arsenic, as one orchardist severely injured the foliage of apple trees from an application of it. In the station experiments the past season, peach trees were sprayed with lead arsenate combined with lime-sulphur preparations with little or no injury, as follows:

(One orchard.)

The first and second sprayings with dry lead arsenate, 2-50, with commercial lime-sulphur at the rate of 1-150.

Two lbs. dry lead arsenate with self-boiled lime-sulphur 8-8-50.

No injury to foliage observed.

(Two orchards.)

First spraying with paste lead arsenate, 3 lbs., with self-boiled lime-sulphur 8-8-50.

A very slight injury to the foliage.

A different brand of paste lead used in each orchard.

In the self-boiled lime and sulphur preparations the lime may tend to neutralize any soluble arsenic that may be present in the lead arsenate. In spraying for the peach sawfly we would advise using only $1\frac{1}{2}$ lbs. of paste lead arsenate in 50 gallons of water.

HOW TO GET RID OF ANTS.

In Lawn or Garden. With a crowbar make holes eighteen inches deep in the nests. If a section of the lawn is infested, holes should be made about two feet apart over the area. In each hole pour about two fluid ounces of carbon disulphide and stop up the opening. The fumes will penetrate the tunnels and kill the ants. Fire should not be used near this liquid, which is inflammable.

In Cellar, Kitchen or Pantry. Place naphthalene flakes in the runways or around the edges of shelves and corners of rooms where the ants usually enter and travel. They are soon driven away.



FIGURE 5. Female Leopard Moth. Natural size.

THE LEOPARD MOTH.*

Zeuzera pyrina Linn. (= *asculi* Linn.)By W. E. BRITTON, *State Entomologist, and*G. A. CROMIE, *Superintendent of Trees
in the City of New Haven.*

APPEARANCE OF INFESTED TREES.

Many of the magnificent elms that have stood as landmarks on the streets and in the central parks of New Haven and other coastwise cities of Connecticut for over a century are dying with little outward apparent cause. And not only are the veterans being destroyed, but trees of all ages suffer where apparently receiving sufficient food and moisture. Dead branches may be seen in numbers, standing above the leafy masses in the tree-tops. Each storm brings down numbers of branches, many of them in full leaf, and if the broken ends are examined, one will notice that just underneath the bark the branch has been girdled. This is the work of an insect that has only within the last few years reached Connecticut, but which has already proved itself our most serious insect enemy of shade trees,—the leopard moth.

Trees recently infested show small twigs broken over and wilted, the leaves on the ends of occasional branches turn yellow and in a few weeks drop. Trees in a later stage show a mass of dead upper branches, as shown on Plate IX, while from the trunk and larger limbs sprouts or suckers appear. Here and there branches are seen with comparatively few, small, sickly leaves. Yet when the tree is cut down the trunk and larger limbs have the appearance of perfect health.

Since the larva bores largely in the sapwood and cambium, the damage done by it is unusually severe, the work of one insect often being sufficient to kill a small tree. Remaining in the wood during the greater part of its life, it is rarely seen by the casual observer, and for the same reason no general and convenient

* This paper was published as Bulletin 169, November, 1911, in an edition of only 3,000 copies, and distributed to entomologists and others known to be interested. It is here reproduced with slight emendations.

methods of controlling it are available, as in the case of insects which eat the foliage. It does not confine its attacks to elms, but is a very general feeder, being found to some extent on nearly all our deciduous trees and larger shrubs. Like many other insect pests that have at various times become unusually destructive, this leopard moth is not a native of this country, but was introduced here probably from Europe. The number of dead branches caused by it not only threatens the life of the tree, but falling from the height to which some of our large trees have grown, are a source of great danger to property and to persons passing beneath them. In Newark, N. J., scarcely a large tree of species susceptible to attack stands to-day, uninjured by this pest, while numbers of young elms recently planted are being deformed.

In Central Park, New York City, Dr. Southwick "has removed hundreds of loads of branches killed by this insect," while in Cambridge, Mass., numbers of old elms have already been removed from this cause.

In New Haven the damage is especially severe in the older sections of the city, within a radius of one mile from the City Hall. On Central, Wooster and Broadway Greens most of the older trees have either been removed or are badly mutilated by the removal of the dead wood. In other parts of the city the insect is present, but severe damage can be found only in occasional groups of trees. Because the female moth is a poor flyer, a tree (or a group of trees) is liable to be the home of succeeding generations as long as portions of it remain alive, while trees only a short distance away are often free from the pest. The trees of New Haven are at present especially liable to injury because they are large and in long, close rows, with interlacing branches, and of species readily attacked.

THIS INSECT A PEST IN EUROPE.

Though apparently the leopard moth is less serious as a pest of shade trees in Europe than in this country, it nevertheless does considerable damage. Theobald⁸⁰ states that it attacks chiefly the cherry, apple, pear and plum in England, but that he has also seen young walnut trees killed by it, and furthermore that "it has been decidedly on the increase in apple trees during the last few years." He also remarks that the leopard moth has

long been known as a borer into the trunks of various trees in England and all over Europe. In addition to the trees just named, Miss Ormerod⁷³ mentions ash, beech, birch, elm, holly, lime, oak and horse chestnut. Gillanders⁷⁸ includes the hawthorn and sycamore among the trees attacked and injured in England. Rev. J. G. Wood⁶⁶ many years ago wrote that though the leopard moth infested fruit trees in England, it seemed to do little if any harm to them. Eckstein⁷² writes of the leopard moth as also attacking syringa, willow, maple, mountain ash and mistletoe in Germany, in addition to the food plants already mentioned here. Kollar⁶⁴ states that in the neighborhood of Vienna the leopard moth injures the trunks of elm, walnut, pear and apple trees. To this list, according to Judeich-Nitsche⁷⁰, may be added linden, poplar, cytissus, alder, pomegranate tree, spindle tree (*Euonymus*) and pine.

The leopard moth is figured in Atlas d'Entomologie⁷⁵ Forestiere, plate 29, by E. Henry.

The foregoing references have been cited here to show that the insect is a recognized pest of trees in Europe, although Dr. L. O. Howard, who has made several trips through Europe, states in a letter that the insect does not seem to be especially destructive in any part of Europe which he has visited.

OCCURRENCE IN OTHER COUNTRIES.

Though the leopard moth is found throughout Central and Southern Europe, according to the Bureau of Entomology⁵⁶ it also occurs in Asia Minor, Northern Morocco, Algeria and South-western Africa. Mr. South⁸¹ states that it is also present in Corea and Japan.

According to P. Lesne,⁷⁹ this insect is the worst pest of the cork oak in Algeria, though after three years work he claims⁸⁴ to have brought it under control by the use of carbon disulphide squirted into the galleries, or better yet, placed in gelatine capsules small enough to be inserted in the burrows. The moisture in the wood dissolves the gelatine in twenty-four hours, and the fumes then kill the borers.

HISTORY OF ITS SPREAD IN AMERICA.

The leopard moth occurs in Europe, and is believed to have been introduced from there into the United States, though the

date of its introduction is uncertain. The species is included by Walker in his list of Lepidoptera in the British Museum,⁶⁵ as occurring in North America, and by John G. Morris in his Synopsis of the Described Lepidoptera of North America,¹ with a brief description, and the locality given as "North America." Two years later (1864) the late Professor A. S. Packard, in his Synopsis of the Bombycidae of the United States² also includes *Zeuzera pyrina* with the same statement as occurs in the Morris catalogue, from which it may have been copied. *Zeuzera pyrina* may also be found in the list (page 10) of North American Lepidoptera, published by the Brooklyn Entomological Society in 1881.

Professor John B. Smith,¹⁴ however, doubts the identity of the species listed as *Z. pyrina* in Walker's catalogue, which Morris, and probably Packard, had followed. Smith visited the British Museum and was unable to find any specimens or records¹⁸ there to warrant Walker's citation that *Z. pyrina* occurred in North America at the time his catalogue was issued.

The first definite record of the occurrence of the leopard moth in America is a short note by Mr. Jacob Doll in Papilio,³ which states: "A fine example of this well-known European species was taken in a spider's web in Hoboken, N. J., in June, last, by Mr. Schmitz. It was alive and was endeavoring to escape from the web. The specimen is now in the collection of Mr. B. Neumoegen." This was written in 1882, and the moth taken in 1881.

Entomological News for March, 1904,⁴⁶ states that this specimen was a female, and was captured in 1879 instead of 1881. Be that as it may, the destructive work of the moth was observed in Central Park, New York City, in 1884, by Dr. E. B. Southwick, and in 1887 at Newark and in 1889 at Arlington and Orange, New Jersey. In 1894, Dr. Southwick pronounced it one of the worst insect pests attacking shade trees.²⁷

In 1894, Smith stated²⁸ that Col. Nicholas Pike reported that the leopard moth occurred in Connecticut. It was soon noticed in cities near New York, though spreading much faster toward the northeast along the coast than in any other direction. In 1905, Dr. Felt⁴⁷ reported the pest at Kensico, N. Y., a point twenty-five miles north of New York City. The earliest Massachusetts record that we can find is that of a male taken by Mr. C. A. Frost⁵⁰ at Medford, July 1st, 1903. In 1907, Professors

C. H. and H. T. Fernald⁴⁹ called attention to the presence of the insect in the vicinity of Boston. In 1909 the senior author learned of its great destructiveness to the trees of Cambridge. Mr. E. H. Armstrong has observed its work at Taunton, Fall River and New Bedford, and Chapman⁶³ reports its presence at Concord, Lowell and Lawrence, as well as at many other places

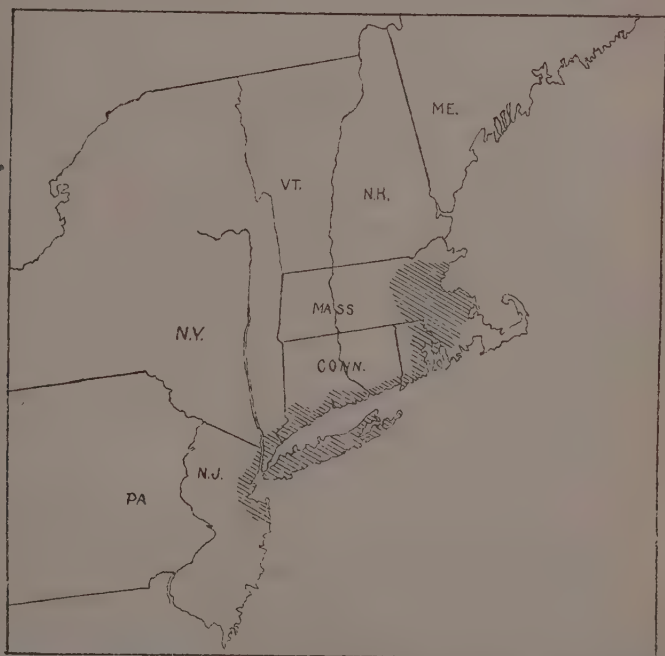


FIGURE 6. Shaded area shows present distribution of the leopard moth in the northeastern states. Cape Cod may also be infested but we have no records to show it.

nearer Boston. Mr. Armstrong is authority for the report that the insect occurs at Providence, Newport, Westerly and East Greenwich, in Rhode Island.

The leopard moth is reported by Professor Smith⁵³ as occurring as far south as Long Branch, N. J., and Mr. Bartlett has seen it at Asbury. At the present time, as is shown by the map, Fig. 6, the insect occurs from Asbury, N. J., at least to the

vicinity of Lawrence, Mass., and in nearly every city along the coast, between these points, much damage has been done by it to shade trees. We have no records of the occurrence of the insect at points more than twenty-five miles inland. It is difficult to explain why it should spread so much more rapidly toward the northwest, along the coast, than in any other direction. Chapman questions⁶⁵ whether the infestation around Boston may not have resulted from a separate and later importation.

DISTRIBUTION AND SPREAD IN CONNECTICUT.

Though, as already stated, the leopard moth was reported to have reached Connecticut by 1894,²⁸ the first definite record that has come to our notice is that of Mr. H. M. Russell, now of the Bureau of Entomology, who formerly lived in Bridgeport, Conn. Mr. Russell collected specimens of the leopard moth at Bridgeport in 1901.⁵⁶

The first Connecticut specimen in the collection of this station was taken in New Haven, July 1st, 1907, by Professor H. W. Foote of Yale University. Since then a number of specimens, chiefly males, have been taken around electric lights. Mr. A. B. Champlain, a former assistant in entomology at this station, collected and observed the males during 1910 and 1911, at several arc lights, including those near the station on Prospect street.

The photograph on Plate IX was taken on the New Haven Green in 1908, and shows that the pest had then been at work for some time, as is evidenced by the dead terminal branches.

Mr. E. H. Armstrong of the Providence Forestry Company, Inc., has informed the senior author that he has observed the work of the leopard moth in New Haven, New London, Mystic and Stonington and that with the exception of Cambridge, Mass., he considers New Haven the worst infested spot that has come under his notice.

Mr. F. A. Bartlett of the H. L. Frost & Bartlett Company states in a letter that he has observed the work of the insect in practically every town and city along the Connecticut coast this year, and that it has been especially serious at Bridgeport and less so at Stamford and South Norwalk. He also saw a little of its work at Danbury, which is about twenty-five miles inland.

Mr. D. J. Caffrey, assistant in charge of the gypsy moth work, observed, in 1911, many trees showing the characteristic leopard moth injury at Wallingford, about twelve miles from the coast.

In September, 1910, the leopard moth was found infesting young apple trees in a nursery at New Canaan, Conn., the adult insect was reared from the larva, and a short account was published in the *Journal of Economic Entomology*⁶¹ for June, 1911. This locality was less than ten miles from the coast. The insect was found again in the same field in September, 1911.

DESCRIPTION.

Adults.—Wing expanse from two and one-half to three inches in the female and about one and three-fourths inches in the male. Wings dirty white and semitransparent, with a yellow or brownish front margin to the fore wings and the same color extending along the principal veins. The wings are marked with metallic blue dots, as shown in the accompanying illustrations, Figure 1, and Plate XVI, *a*. The markings are much more



FIGURE 7. Leopard moth caterpillar. Dorsal and lateral views, natural size.



FIGURE 8. Pupa, natural size.

pronounced in the female than in the male, which sometimes has very faint dots. Color much brighter in the female. Thorax white or yellow dorsally, with six blue-black spots, three in a row on each side. Ventral side, black; abdomen, black, with more or less whitish pubescence, and the female has an extensile three-jointed ovipositor, by means of which eggs are laid under the edges of bark; legs, black; the second and third pairs of femora bearing whitish woolly hairs. The female has thread-like and the male feathery antennæ. The female is shown in Figure 1, and both sexes on Plate XVI, *a*.

Egg.—The eggs are about the size of a pinhead, or one-sixteenth of an inch long, oval, somewhat pointed, and salmon or orange-yellow in color. They are usually laid singly or in groups of two, three, or four each. Shown on Plate XVI, *b*.

Larva.—Length about two and one-fourth inches, dirty white, dull yellow, or flesh-colored, marked with dark brown or black tubercles, each bearing a short bristle. The fourth to the tenth segments inclusive bear two pairs of tubercles, the front pair being closer together than the rear

pair. The second, third, eleventh and twelfth segments have smaller tubercles arranged more nearly in transverse rows. Laterally, there is a row of brown tubercles just above and another row just below the spiracles. A second row of smaller tubercles may be seen on the bases of the legs and pro-legs. The large cervical shield and smaller anal shield are dark brown. Head, dark brown, with upper part of front lighter. Legs, light brown. The larva is shown in Figure 7, and on Plate XVI, *c*.

Pupa.—About one and one-half inches long, scarcely tapering, anal extremity, blunt; dark brown in color. On the proximal and distal margins of each abdominal segment there is dorsally a ridge consisting of a number of short, black spines or teeth, pointing backward. Similar spines or hooks, projecting forward, occur on the ventral surface of the posterior segment. Shown in Figure 8.

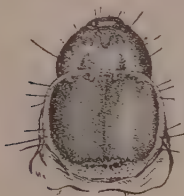


FIGURE 9. Head and cervical shield of larva, much enlarged.



FIGURE 10. Anal plate of larva, much enlarged.

All stages of the leopard moth are shown in the accompanying illustrations.

LIFE HISTORY AND INJURY.

Just as the manuscript of this bulletin was ready for the printer, a publication on the same subject by James W. Chapman,⁶³ and published by the Bussey Institution of Harvard University, came to hand. Mr. Chapman, by original observations, has made an important contribution to the habits and life history of this insect, and we have, therefore, revised several paragraphs in this bulletin, to include the chief results of Mr. Chapman's studies.

The adult moths appear during a period extending from May to September, according to the circular issued by the Bureau of Entomology.⁵⁶ In New Haven, however, by far the greater number are found during the early part of July, while specimens have been secured during late June and the first week in August. The male is much the smaller, and flies with ease, being attracted

by the electric lights. The female has a heavy body, and flies very little, preferring, if possible, to lay eggs on the same tree where she emerged from the pupa. For this reason, high trees, isolated, and one hundred feet or more away from others injured by the leopard moth, may remain uninfested for years, while continuous rows of trees with branches touching are soon infested throughout.

The moths eat nothing and live at the most but a few days, the male dying immediately after copulation, the female as soon as the eggs are laid. One female captured by the junior author lived three days.

The eggs are inserted in crevices in the bark, or beneath plates of bark, one to several in a place, usually in the higher branches of the tree. They may, however, be laid on larger branches or on the trunks of small trees. They are less than one-sixteenth of an inch in length, oval, and yellowish or salmon colored. Several observers, including the junior author, have found the eggs laid by females in confinement, in several masses, due, no doubt, to the unwillingness of the female to deposit them sooner than necessary under unsuitable conditions. Numbers of the borers, just hatched, were found, and in every case they were working singly, usually just above a bud or twig on one of the smaller branches. This, according to J. W. Chapman,⁶³ means that the new larvæ do not enter the branch at the place where they hatch, but crawl some distance to the smaller twigs. Although this is the rule, the junior author has found several which had entered branches two to five inches in diameter, taking advantage of crevices in the bark. Each female may deposit from 400 to 800 eggs.

The larvæ hatch within a few days (ten days, according to Mr. Walker²⁶), being plentiful in the latter part of July, and immediately commence their destructive work, boring into the branches. A careful examination of the twigs of an infested tree will show a slight amount of the white, powdery sawdust expelled by each larva during the first few days after hatching. In a few days the character of the expelled frass changes to small cylindrical pellets, light golden or brown in color.

Several experiments made by Mr. J. W. Chapman⁶³ are of value in showing the activity of the newly-hatched larvæ. A number of these were placed at the base of a fresh lilac bush

and soon commenced to climb. On reaching the twigs, they were at once taken off and again placed at the base, when they would immediately commence climbing again. In this way four of those making the greatest progress had in four hours traveled distances varying from twenty-five to eighty feet.

Other experiments showed that some of the more recently hatched larvæ were able to crawl from fifty to one hundred feet on the ground, through grass and rubbish, while others nearly full-grown would move very little, but would protect themselves by spinning together small particles of sticks and dirt.

Growth is rapid, and the larvæ reach a length of about an inch by the end of the first season. The general tendency is for the insect to work upward from the hatching point, or from any opening made for expelling the frass. Small twigs are hollowed out, leaving little but a shell of bark, and small branches may be girdled, causing them to break off during a heavy rain. Where the young hatch in larger branches, the regular burrows are often varied by small, irregular patches eaten out of the inner bark. Branches too small, in a dying condition, or otherwise unsuitable, are vacated, the insect crawling on the outside of the bark and making a fresh entry on another and usually larger branch. A burrow may strike a knot or small branch, when, after going back several inches, the insect starts in a new direction. New outlets may be made, and the use of old ones discontinued from time to time. These outlets are always in some protected situation on the under side of a branch or in a crotch. They are kept covered with a closely woven silk web, this being broken and remade each time the frass is expelled. In one case the web was broken by the junior author and remade by the insect five times within an hour. This web certainly helps to conceal the hole, and may be used to keep out air, parasites, ants and other insects. Unlike the galleries of the sugar maple borer, those of the leopard moth are kept clear, all frass being removed as soon as a small pile has accumulated, and cement sidewalks under badly infested trees are often littered with the brownish pellets expelled from the burrows.

During the latter part of October the larvæ leave the outer wood and bore slanting holes upwards and into the wood two inches or more from the bark, where they remain in a dormant stage over winter. Sharp⁷⁴ cites Kalendar to the effect that the

larva forms a temporary cocoon in which it passes a winter sleep before again feeding in the spring, but this is not the case in Connecticut, as Mr. Cromie has taken numbers of naked larvæ from the branches during winter.

The boring is continued in the same manner during the next summer, but the damage done is now much greater, both the insect and the branches attacked being larger. Branches four to eight inches in diameter may be entirely girdled, or large patches of wood may be eaten out. The wounds made the preceding year now show at their worst, the bark falling away, and ugly ridges being made where they have partially healed.

When fully grown, the larvæ are about two and one-fourth inches in length, and most of them do not enter the pupa state until the early part of the succeeding summer, when they are nearly two years old. The writers have reason to believe that some of those hatched early change to pupæ and complete the life cycle as those appearing latest during the next year. However, those passing the second winter continue active boring in the spring, changing to brownish pupæ in May or later. This is done in a small chamber within a few inches of where the larva has previously cut its way almost through the bark. It also further protects itself, before pupating, by a fine web placed between itself and the place of exit. In from four to six weeks the pupa cuts through the bark and, by means of protuberances on the abdominal segments, wriggles itself partially out of the hole, where it leaves the shell or pupa case after it flies, as may be seen on Plates XI, *b*, and XV.

As shown before, this insect attacks to some extent nearly every tree, native or exotic, growing in this region, except evergreens, so that a full list is not necessary. However, in New Haven the American elm is one of the kinds most severely attacked, while, owing to its dark, plated bark, even on the smaller branches, the insects in it are very hard to detect. With it, in amount of injury done, may be classed the silver maple and the sycamore maple. Other common species often seriously injured are ash, English elm, basswood or linden, tulip, sugar, red and Norway maples, poplar and horsechestnut. The honey locust, sycamore, sweet gum, and oak seem much less liable to attack, in many cases, in New Haven, remaining uninjured, although standing in rows with affected elms.

NATURAL ENEMIES AND CHECKS.

In this country no parasites have been recorded that hold the leopard moth in check. In Europe a chalcidid parasite of the subfamily Encyrtinae, *Litomastix* (*Copidosoma*) *truncatella* Dalm., has been reared by E. A. Fitch. (Entomological Magazine, Vol. XVIII, p. 116.) This and an ichneumonid, *Schreineria zeuzerae* Schrein (not Ashm.), are mentioned in a letter to Mr. Cromie from the American Consul-General at Berlin, the information being received by him from the Kaiserliche Biologische Anstalt für Land- und Forstwirtschaft in Dahlem-bei-Steglitz. The former, *L. truncatella*, is probably the same as was reared in this country from the cabbage looper, *Plusia brassicae* Riley. (Rept. of Ent. U. S. Dept. Agr. 1883, p. 121.)

An examination of hundreds of the caterpillars and pupæ, as well as the burrows made by them, shows that the leopard moth is remarkably free from natural enemies of all kinds. In no case was there evidence of either parasitic or predaceous insects. Dr. L. O. Howard, who has given some attention to the subject, has not found that any effective parasitic check exists even in Europe, though he has promised to bring to America the species known to occur there. Mr. Cromie found in New Haven a caterpillar dead in its burrow and full of small maggots, but these proved to be a Phorid fly, *Aphiochata nigriceps* Loew., which probably did not attack the borer until after it had died from some other cause. This was the only indication found of an insect being destroyed while in its burrow. All pupæ, the stage generally exhibiting parasitism, seemed to have developed properly. Undoubtedly some check to the insect must exist before the burrow is developed, because of the small number of burrows found as compared with the large number (several hundred) of eggs, laid by each female. Either the female is unable to deposit any large number of her eggs in proper situations, and they thus fail to hatch, or the eggs themselves are largely eaten by the birds or insects found in cities. The writers have noticed that English sparrows search for and apparently find food on elms infested by the leopard moth in July, when the eggs should be plentiful and the young borers just hatching, but their prey might have been other insects. In many cases small holes, barely started by newly hatched larvæ, were found vacant, indicating that birds had secured the insects before they were able to enter the wood.

As the leopard moth is a pest chiefly of cities and towns, it is thought that certain birds, especially woodpeckers, assist in checking it, especially in the country districts. The habits of the moths in flying about electric lights would lead one to expect that many of them might be eaten by bats and night-flying birds. It is also believed that sparrows sometimes may feed upon the eggs or young larvæ. Smith states⁵⁸ that the leopard moth is a serious pest only where the English sparrow has driven away the native birds.

No other explanation can be given of the scarcity of the leopard moth in the country, adjacent to infested towns, except the presence of insectivorous birds. This tendency of the insect to become a pest only within cities and towns is noted by several English, French and German writers, as well as in this country. Mr. James Walker of Newark, N. J., states that infested elms placed in a nursery outside the city limits of Newark were rid of the larvæ by woodpeckers. This coincides with a statement made by P. Lesne,⁷⁹ who mentions having seen in Northern Algeria numerous woodpecker holes ending in the burrows of the leopard moth. While traveling from one branch to another, a habit of this insect, it is exposed to the attacks of birds. Mr. J. W. Chapman⁶³ also cites evidence of squirrels in the Boston parks chewing the smaller branches to secure the larvæ, which they relish.

Especially in early summer, numbers of small girdled branches in full leaf are broken off by storms. Nearly all of these contain the caterpillar which has done the girdling, and the branch soon wilts and dies. Though most of the larvæ desert the branch within two or three days after it falls, the junior author has found several of these shrunk and in a dying condition on the branch, showing that the insect cannot sustain life on the dead wood. It is also evident that very few of those which leave the branch are able to again find and climb a large tree. On city streets these branches are usually gathered at once and destroyed because of their hindrance to traffic. In parks it is even more necessary that this should be done, as here the insects can easily leave the fallen branches and enter shrubbery or small trees.

REMEDIAL TREATMENT.

In view of the protected life led by this insect, treatment is especially difficult. Tunneling under the bark during the greater

part of its life, it is not affected by arsenical or contact sprays. The protracted period during which it may appear as a moth hinders effective action against the adult. Isolated trees recently infested, and small trees with smooth bark, can be saved by a thorough inspection two or three times a year, followed by the removal of badly infested branches and the destruction of larvæ found, either by the injection of carbon disulphide (bisulphide) into their burrows or the insertion of a hooked wire to draw them out. Large trees badly infested should be cut down at once.

Unfortunately, this insect lives so concealed a life as to attract little attention until it is well distributed in a town or city and serious damage has been done to the trees. Where not already present, all planting stock should be bought from nurseries free from this pest,—probably in a district not yet affected. A careful watch must be kept for its first appearance, when, because of the inability of the female to make long flights, the removal of the trees for a couple of hundred feet around the affected section will form a quarantine that will greatly help to keep it in check. Special attention can then be given to all trees in and close to the affected area. Most citizens are averse to having trees removed from in front of their property until they are very far gone, but stern measures are necessary in preventing the spread of this insect.

Electric Lights. The moths are attracted by the strong arc lights used for street lighting, and numbers of them, largely males, could be secured in the flying season by sending men around to collect them from nine to twelve o'clock at night, or by the payment of a small bounty to boys, according to the quantity collected. This method of check, especially where females are secured, is of immense value, as it is much easier to prevent eggs being laid than to find the larvæ, which would otherwise hatch.

Mr. J. W. Chapman,⁶⁸ during the month of July, had placed in the Harvard College yard three six ampere arc lights, without globes or reflectors. About twelve inches beneath each light a pan three inches deep and twenty-four inches in diameter was suspended by wires. The pan was then half filled with water, with a thin film of kerosene on top. These lights were run as traps during the first two weeks of July, the insects being

attracted to the lights and then falling into the pan and being killed by the oil. In this way 279 male and 58 female moths were taken. Undoubtedly if the traps had been placed during June, when the moths first began to fly, a correspondingly larger number would have been taken.

Removal of Affected Branches. Trees badly affected are best removed, as the pruning of large numbers of branches leaves only mutilated specimens not worth the cost of the repeated inspection and treatment required.

Pruning should be done while the tree is in foliage, preferably twice a year, once in spring and once in late summer. The number, size and color of the leaves is the best guide as to affected branches. The tendency is not to remove many of these, which, if left, will probably die later in the season, or at least harbor numbers of eggs and of the young larvæ whose work does not yet show. All dead branches should be removed at a point well below the beginning of the green wood, so as to be more likely to secure the insects doing the damage. Branches containing small leaves, leaves thin or yellowish in color, or those where the leaves are few and scattered, are sure to be infested and should be removed.

Inspection, and Destruction of Larvæ. On large numbers of trees over fifty feet in height, the expense of this method is prohibitive, and the difficulty of locating the insects renders it impracticable. Especially is this so with elms of even smaller size, because of the rough, scaly bark on all but the smallest twigs. Also on such trees the branches are very numerous, long, slender and horizontal, making climbing in some places impossible.

To find out how successfully this method could be applied to large elms, the junior author selected several badly infested ones, sixty to eighty feet high, and had two of his best climbers treat them under his personal inspection, without limiting them as to time. Then live branches which had thus been carefully examined were cut from the tree and the bark peeled with a draw knife, exposing all leopard moth galleries. Less than twenty-five per cent. of the larvæ on the infested branches had been secured while on the tree. Also, Mr. Chapman, in describing the experiments in Harvard College yard, states that previous to placing the trap lamps, in which over three hundred moths were secured, "the

yard had been patrolled since early spring by three men, who spent their entire time searching out and destroying the larvæ and pupæ of the moth."⁶³ On smaller trees, in New Haven, especially of species with smooth bark, it was found possible, by a thorough inspection, to secure practically all of the older larvæ.

In East Orange, New Jersey, where there are few elms, and the trees are, as a rule, from ten to fifty feet in height, the following method, carefully applied for three years, has placed the leopard moth under control:—Gangs of men, trained to the work, in August and September of each year look on the ground and sidewalk under every tree for the piles of brownish pellets and sawdust dropped by the borers. Carefully spotting the branch over each pile, the man climbs the tree and, if experienced, can locate nearly every hole, which, at that time, is covered by the silk web, when the insect is either secured with a wire, or carbon disulphide is injected from a small oilcan, and the hole stuffed with putty or soap.

Although the burrows are usually well cleared of frass, allowing the fumes of the carbon disulphide free access, there may be other outlets to the burrow, so the method of securing the insect with a wire is surer. A piece of No. 16, soft, steel wire is used, one end being bent into a very small hook, and sharpened from time to time by cutting the end of the hook in a slanting direction with a pair of linesman's pliers. Often the insect cannot be reached without cutting the burrow open for some distance with a stout jackknife, but this is easily done, as there is only the bark to cut through, and the real injury is not increased. If the branch is found to be nearly girdled, it had better be cut off.

In this way the larger larvæ (those in their second summer), which, of course, are found in the larger branches, are destroyed, preventing the laying of eggs the following summer. The same method is followed out the succeeding fall, when the younger larvæ, which, by this time, have grown large and come down to the larger branches, are also procured.

In high trees, the wind so scatters the falling pellets as to make it impossible to ascertain from their location on the ground the number or location of the insects in the tree.

Disposal of Infested Wood. It is very often not convenient in large towns or cities to burn the infested wood secured after

storms or by the trimming and removal of trees. Often the wood could be utilized by people in the vicinity in which it is collected, or it may be left at some nearby public dump.

During the spring of 1911, the junior writer secured a number of branches broken off by storms, and containing larvæ. The borers remained in the wood for a few days, until the leaves began to wilt and the wood commenced to dry, when most of them left the branches. Unable, however, to find new green branches to enter, they soon grew thin and died. Mr. Chapman,⁶³ with older larvæ, secured later in the season, found that the borers were able to exist during the winter in wood removed from the tree and to emerge as moths the following spring. Unless the wood is to be used immediately, or placed in a dump where they will soon be buried by ashes, dirt, etc., branches secured by trimming or blown down by storms should be burned.

Care in Planting. Until some effective check is found for this insect, it is best not to plant too heavily those species of trees which are especially liable to attack. Species with short, strong branches, covered with smooth bark, should be given the preference, being more easily inspected and taken care of by the methods just given. Planting the young trees a greater distance apart than usual, makes it more difficult for the insect to spread from one tree to another.

In this connection, it might be said that, in Brooklyn, one of the first cities in America to be infested, Mr. J. J. Levison reports the insect as far less injurious than formerly, although no direct measures have been taken for its control, and the junior author has seen there rows of elms and other trees almost untouched by this insect.

Care of Trees. Although trees in good health are not immune to attack, many authorities claim that they are less liable to injury than unthrifty trees. It is certain that in New Haven the greatest damage by the leopard moth has been done to trees on streets where the conditions are most adverse to tree life, and at least wounds are more easily healed, and recovery after attack is surer, where the trees are kept in a thrifty condition.

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- 17 Riley, C. V. and Howard, L. O. Insect Life, vol. iv, p. 77-8 (notes of correction).
- 18 Smith, J. B. Canadian Entomologist, vol. xxiv, p. 136 (remarks on Walker's citation; doubts identity).
- 19 Smith, J. B. Entomological News, vol. iii, p. 206 (note).
- 20 Southwick, E. B. Insect Life, vol. iv, p. 61 (note).
- 21 1893 Riley, C. V. and Howard, L. O. Insect Life, vol. v, p. 204 (note of correction).
- 22 1894 Neumoegen, B. and Dyar, H. G. Journal New York Entomological Society, vol. ii, p. 160 (descr. *pyrina*).
- 23 Riley, C. V. and Howard, L. O. Insect Life, vol. vi, p. 40 (note on number of eggs).
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- 25 Smith, J. B. New Jersey Agricultural Experiment Station, Bull. 103, p. 9.

- 26 1894 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 519 (good acct.).
- 27 Southwick, E. B. Report Entomological Society Ontario, xxv, p. 107 (recent destruction in New York).
- 28 1895 Smith, J. B. Insect Life, vol. vii, p. 138 (report by Pike from Connecticut).
- 29 Southwick, E. B. Insect Life, vol. vii, p. 136 (mention of injury).
- 30 1896 Smith, J. B. Economic Entomology, p. 287 (brief illus. acct.).
- 31 1897 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 397 (mention).
- 32 Webster, F. M. Ohio Agricultural Experiment Station Bull. 77, p. 48 (illus. acct.).
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- 34 Felt, E. P. Report of Commissioners of Fisheries, Game and Forests, iv, p. 16 (illus. acct.).
- 35 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 385 (mention).
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- 37 Smith, J. B. Insects of New Jersey, Suppl. Report N. J. Board of Agriculture, p. 497 (brief acct., illus.).
- 38 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 445 (mention).
- 39 1900 Britton, W. E., et al. Connecticut Agricultural Experiment Station Bull. 131, p. 13 (mention).
- 40 Felt, E. P. New York State Museum, vol. viii, No. 37, p. 23 (note, illus.).
- 41 MacCartney, B. F. Report Pennsylvania Department of Agriculture, p. 94 (brief illus. acct.).
- 42 1901 Felt, E. P. Report New York State Entomologist, xvii, p. 745 (occurrence at Newark, N. Y.).
- 43 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 480 (mention; not so destructive).
- 44 1903 Gibson, A. Report Entomological Society Ontario, xxxiv, p. 61 (mention).
- 45 Holland, W. J. Moth Book, p. 376 (illus. acct.).
- 46 1904 Doll, J. Entomological News, vol. xv, p. 110.
- 47 1905 Felt, E. P. Insects Affecting Park and Woodland Trees, vol. i, p. 75 (full acct., illus.).
- 48 Smith, J. B. New Jersey Agricultural Experiment Station Bull. 181, p. 29 (brief acct.).
- 49 1907 Fernald, C. H. and H. T. Report Massachusetts Agricultural Experiment Station, p. 155 (short note, damage near Boston).

- 50 1907 Frost, C. A. *Psyche*, vol. xiv, p. 63 (appearance in Mass. in 1903).
- 51 1908 Britton, W. E. Report Connecticut Agricultural Experiment Station, p. 847 (presence in Conn.).
- 52 Smith, J. B. Report New Jersey Forest Commission, p. 89.
- 53 Smith, J. B. Report New Jersey Agricultural Experiment Station, p. 315 (mention).
- 54 1909 Britton, W. E. Report Connecticut Agricultural Experiment Station, p. 356 (acct.).
- 55 Fernald, C. H. and H. T. Report Massachusetts Agricultural Experiment Station, part 2, p. 72 (mention).
- 56 Howard, L. O. and Chittenden, F. H. Bureau of Entomology Circular 109 (full acct., illus.).
- 57 Reiff, Wm. *Psyche*, vol. xvi, p. 28 (larva in oak).
- 58 Smith, J. B. *Insects of New Jersey*, rev. ed., Report New Jersey State Museum, p. 516 (illus. acct.).
- 59 1910 Britton, W. E. *Journal Economic Entomology*, vol. iii, p. 436 (mention).
- 60 Britton, W. E. Report Connecticut Agricultural Experiment Station, p. 664 (mention).
- 61 1911 Britton, W. E. *Journal Economic Entomology*, vol. iv, p. 298 (on nursery stock, illus.).
- 62 Solotaroff, Wm. *Shade Trees in Towns and Cities*, p. 182 (illus. acct.).
- 63 Chapman, J. W. *The Leopard Moth and other Insects Injurious to Shade Trees in the Vicinity of Boston*. Bussey Institution, Harvard University (full acct.).

EUROPEAN.

The authors have made no attempt to give a complete list of European writings on the leopard moth. A few are here cited from works on hand to indicate the status of the insect as a pest in Europe.

- 64 1840 Kollar, V. *Insects Injurious to Gardeners, Farmers, etc.*, p. 207 (brief acct.).
- 65 1854-66 Walker, F. *List of Specimens of Lepidopterous Insects in the Collection of the British Museum*.
- 66 1873 Wood, J. G. *Insects at Home*, p. 428 (brief illus. acct.).
- 67 1874 Kaltenbach, J. H. *Die Pflanzenfeinde*, pp. 73, 184, 429, 548, 774 (mention of food plants).
- 68 1890 Ormerod, E. A. *Manual of Injurious Insects*, p. 320 (brief illus. acct.).
- 69 1892 Ormerod, E. A. *Text Book of Agricultural Entomology*, p. 132 (mention, illus.).
- 70 1895 Judeich (J. F.)-Nitsche (H.) *Forstinsektenkunde*, p. 773 (illus. acct.).

- 71 1895 Schlich, Wm. Manual of Forestry, vol. iv, p. 264 (descr. note about injury and food plants).
- 72 1897 Eckstein, K. Forstliche Zoölogie, p. 479 (brief acct.).
- 73 1898 Ormerod, E. A. Hand Book of Orchard and Bush Fruit Insects, p. 132 (illus. acct.).
- 74 1901 Sharp, D. Cambridge Natural History, vol. vi, p. 395 (mention).
- 75 1903 Henry, E. Atlas d'Entomologie Forestiere, p. 29 (illus.).
- 76 1904 Theobald, F. V. Report on Economic Zoölogy, ii, p. 30 (note).
- 77 1905 MacDougall, R. S. Journal Board of Agriculture (London), 12, No. 2, p. 115. Abstract Expt. Sta. Record, vol. xvii, p. 1092 (remedial treatment).
- 78 1908 Gillanders, A. T. Forest Entomology, p. 247 (brief illus. acct.; sycamore, hawthorn).
- 79 Lesne, P. Compt. Rend. Academy Science (Paris) 146, p. 493 (great damage to cork oak in Algeria).
- 80 Theobald, F. V. Report on Economic Zoölogy, p. 24 (brief note).
- 81 1909 South, R. The Moths of the British Isles, p. 348.
- 82 Theobald, F. V. Insect Pests of Fruit, p. 46 (illus. acct.).
- 83 Theobald, F. V. Report on Economic Zoölogy, p. 29 (brief note, illus.).
- 84 1911 Lesne, P. Compt. Rend. Academy Science, 152, p. 1269. Abstract Expt. Sta. Record, vol. xxv, p. 464 (larvæ in cork oak).

SUMMARY.

The leopard moth occurs in Europe and parts of Asia and Africa, and was probably accidentally introduced into this country from Europe more than thirty years ago, being first noticed at Hoboken, N. J., and later spreading toward the north and east along the coast. At the present time it is found from Asbury, N. J., to Lawrence, Mass., but has not been taken more than twenty-five miles inland.

The larvæ or caterpillars cause great damage to nearly all kinds of shade trees by boring in the branches just under the bark and cutting large galleries, often across the grain, thus girdling them. Dead branches extending above the mass of foliage in the tree-tops are a sign of attack, and many twigs will be broken off or wither during the summer. The pest has been especially destructive to elm and silver maple trees in the coast cities and towns of Connecticut, but is not so abundant in the open country. It has caused much damage also in the cities of New Jersey, New York City, Providence, Cambridge and Boston.

The adult moths are dirty white, with semitransparent wings marked with metallic blue dots. These have an expanse of one and three-fourths inches in the male to two and one-half inches in the female. The larva is yellow or dirty white, marked with brown or black dots, and about two inches long. See illustrations.

The moths appear about July 1st, the males being very common around electric lights, and the females lay eggs singly or in groups of two, three or four, in the crevices of the bark or near the buds. The larvæ, hatching in a few days, begin to tunnel in the twigs, and by the end of the season are about one inch in length. They leave the small branches and crawl over the bark to enter larger ones, cutting large galleries in them and expelling the frass through round holes, which they soon close with silk webs. During October the borers go deeper into the wood, and remain through the winter two inches or more beneath the bark. They pupate in their burrows the second spring, and before the moth emerges the pupa works itself partly out of the opening, and the adult flies away, leaving the empty case protruding from the burrow.

There are few natural checks, only one parasite being known in this country and four in Europe. It is believed, however, that certain birds, especially woodpeckers, prevent the spread of the leopard moth in the open country. Many larvæ are doubtless killed by the breaking off of the branches, which in cities are carted away and destroyed.

Removing infested branches; injecting carbon disulphide (bisulphide) into the burrows, and stopping the opening; probing with a hooked wire for the larva; are some of the methods of control.

Planting species of trees not badly infested, like oaks, honey locust and sycamore, and especially those kinds that do not grow very large, and have a smooth bark; placing trees further apart, so that the larvæ cannot easily crawl from one to the other; and keeping the trees well nourished and vigorous, are the chief preventive measures.

HOW TO GET RID OF FLIES.

Flies breed in filth and then travel over food. They are especially attracted by filth and by the odors of the pantry and kitchen. Coming from foul and decaying animal and vegetable matter, their feet and bodies carry many germs which may be and are deposited upon human food. Several important diseases of mankind are spread in this way, including typhoid fever, cholera and dysentery.

Though flies may breed in any decaying animal or vegetable matter, probably ninety-five per cent. of them develop in stable manure.

Life Period. Each female may lay 120 eggs, which hatch in less than twenty-four hours, and the maggot and pupa stages each last about five days, making only ten days from the egg to the adult fly. The adult fly may live for many weeks.

Abolish Breeding Places. Prevent the breeding of flies by not allowing manure to accumulate about stables. It should be

removed once each week. If not feasible to do this, keep it in a screened shed or cellar, or treat it with oil every few days. Garbage cans and swill tubs should be covered, and not kept near the kitchen. Sanitary closets should be maintained.

Screen all Human Habitations. In order to reduce the danger of contracting disease through the agency of flies, these insects should not only be reduced in numbers, but even the few should be kept out of houses. All rooms should be provided with screens. It is especially important that the dining room, kitchen and pantry should be kept free from flies, and it is equally important to keep flies from the sick room.

Food should never be exposed to flies.

To Kill Flies in Houses. 1. One of the best fly poisons is formalin mixed with water in about five per cent. strength, exposed in a shallow dish. The flies will drink it and die. Professor R. I. Smith of the North Carolina Station recommends one tablespoonful of commercial formalin to a half-pint cup of half milk and half water, placed on a shallow plate, with a slice of bread in the liquid. The bread gives more surface upon which the flies may alight. Formalin fly poison is not dangerous to use and is especially successful in reducing an abundance of flies if the room can be closed and if they do not have access to any other form of moisture.

2. Traps are also serviceable.

3. A liberal use of insect powder (Pyrethrum) in a tight room will stupefy the flies and they may be swept up and burned.

4. Sticky preparations such as "Tanglefoot" fly-paper will catch many flies.

5. Use wire fly-killers to destroy stragglers.

BRIEF NOTES.

A Migration of the Cotton Moth into Connecticut. During the last week of September a swarm of brown moths appeared in New Haven and probably other Connecticut towns and cities. It was the cotton moth, *Alabama (Aletia) argillacea* Hubn., from the Southern States, which in its larval stage feeds only upon cotton, and is believed not to hibernate in the United States, except possibly in Texas. The great abundance of this insect in the South in 1911 was mentioned by Mr. W. D. Hunter in a

paper given at the Washington meeting of the American Association of Economic Entomologists, December 27-29, 1911. Considerable injury to the cotton plant resulted from the attacks of the caterpillars.

In New Haven, the moths were resting by hundreds on the walls of the railroad station, and other buildings, especially near the water front, were literally covered. The following account was copied from one of the local papers:

Army of Moths Nearly Tie Up Railroad.

"Swarms, several of them, containing a few millions, more or less, of brown moth millers have descended on Union station, and the trainmen's shanty, and for a time so large was the number of the invading host that they made folks about the depot think a heavy storm was coming up. The moth millers settled themselves at the east end of the station on platform pillars on the side of the depot and some more swept to the west end and beyond and cluttered up the walls of the trainmen's shanty just west of the station to such an extent that there was scarcely a spot where the boards could be seen. The visitors were most active when the sun came out periodically during the day.

It was reported that they settled so thickly on the rails near the yard master's shack in the Water street yard that a switcher with a small string of cars behind it could not get under headway because the wheels of the locomotive, passing over the millers, slipped."

Another newspaper stated that the brown-tail moth had reached the city in great numbers, and threatened to do much damage. On September 25th I counted thirty of these moths inside a closed trolley car on Whitney avenue on the way to my office. During a residence of nearly eighteen years in New Haven I have never before observed or collected this insect, though the station collection contains specimens taken in Waterbury by Mr. H. S. Woolley. Such a swarm is therefore unusual, but the migration in 1911 was extensive and widespread, according to reports in Science by Professor H. T. Fernald, who observed the moths at Amherst, Mass., and Mr. J. L. Randall, who reports them at Pittsburgh, Pa. Dr. Henry Skinner, in Entomological News for November, page 415, records them as being present in great numbers at Philadelphia, and Mr. R. A. Muttkowski, in the same journal for February, 1912, page 83, records the abundance of the moths in the vicinity of Milwaukee, Wis. In the Ottawa Naturalist for 1911, page 129, Mr. Arthur Gibson reports it as being unusually abundant throughout Western Ontario in September, 1911. A

single example was received from Mr. H. S. Douglas of New London. Professor John B. Smith states* that, though the cotton moth does not breed in New Jersey, "each year adults fly north in considerable numbers after midsummer, and some of these flights reach us, as a swarm or in scattering individuals."

A Dipterous Parasite of the Imperial Moth. Mr. Champlain collected a chrysalis of the imperial moth, *Basilona imperialis* Dru., cutting it out of the ice on the edge of a pond at Lyme, Conn., December 4th, 1910. On February 6th, 1911, the chrysalis was fractured and showed six Tachinid puparia inside. On April 20th a perfect specimen emerged of one of our large Tachinid species, *Latreillimyia bifasciata* Fabr. This fly has a body about half an inch long, thorax grey or pruinose, abdomen black, with two yellow bands on last two segments. Body more or less covered with stiff hairs or bristles.

A Borer in Spruce Twigs. On June 4th, 1910, a spruce twig containing a borer was received from a local nursery. The borer was a lepidopterous larva not familiar to us, and was placed in the breeding cages. The adult proved to be a small pyralid moth, and was identified by Dr. H. G. Dyar of the U. S. National Museum as *Dioryctria abietella* D. & S. Dr. Dyar stated that the specimen was typical, and like those from Europe, but was different from those reared in this country from pine cones.

Prevalence of Hickory Bark Borer. The hickory bark borer *Scolytus quadrispinosus* Say has caused much damage to native hickory trees, especially in the southwestern part of the state, during the season. Some trees in New Haven show signs of attack. This is the same beetle that in 1901 killed more than 110 hickory trees on the Hillhouse place in New Haven. The infested trees were cut, which is about the only remedy. An account of this insect may be found in the Report of this Station for 1901, page 267, and the beetles and their work are shown on Plate VIII of that report. Utilizing the trees for timber and fuel and destroying the bark and refuse before May 1st will kill most of the overwintering beetles in the bark.

The Apple-Leaf Crumpler. On May 12th, 1911, a case-bearer with trumpet-shaped case on apple was received from Mr. E. D. Curtis of Litchfield. Adult moths appeared in the breeding cages June 21st, and proved to be the apple-leaf crumpler,

* Report N. J. State Museum: Insects, p. 471. 1909.

Mineola indiginella Zell. The larva also feeds upon plum, cherry and quince, but is seldom destructive, especially if spraying is generally practiced to control the codling moth. The adults are shown on Plate II, a.

Chrysanthemum Leaf-Miner or Marguerite Fly. On April 8th we received from R. H. Comstock of Milford a plant of marguerite daisy having leaves infested with the chrysanthemum leaf-miner or marguerite fly, *Phytomyza chrysanthemi* Kow. The leaves were badly tunneled by the larvæ, some of which had pupated in the tunnels. On April 16th the first adult, a small two-winged fly, emerged, and by April 20th a good series of adults had been obtained. This is probably a native American insect, and attacks chrysanthemums, marguerites, feverfew, cinerarias, eupatoriums and tansy. The eggs are laid in or on the under sides of the leaves and after hatching the minute larva mines or tunnels in the tissues of the leaf between the upper and lower epidermal layers, the mined areas showing as whitish markings on the green leaves. The damage has been so great in some instances that the growers had to abandon the commercial growing of these plants. Gathering and destroying the infested leaves, especially the first ones to appear, has been practiced with good results. Where greenhouses can be fumigated with hydrocyanic acid gas, this would undoubtedly prove the most effective of any treatment. It is also probable that some of the oil or nicotine sprays may penetrate sufficiently to destroy the larvæ.

Tent Caterpillars. The apple tent caterpillar, *Malacosoma (Clisiocampa) americana* Harr., has not been very common in the vicinity of New Haven for several seasons. Apparently it is more abundant elsewhere, judging by the letters received. Specimens were sent from Westport, Stamford, New Haven, Union, and Lisbon. This insect has been mistaken for the gypsy moth, but is entirely different in appearance, as the caterpillar is more decidedly brown in color, and with a more prominent white dorsal line than the gypsy caterpillar. Neither does the former bear prominent tubercles, or such conspicuous bristly hairs. Moreover, the tent caterpillar is found chiefly on apple and wild cherry, and it makes a nest in the forks of the branches, remaining within the nest at night and during stormy weather, but going out of it to feed on pleasant days. When about fullgrown, the caterpillars have a habit of clustering on the outside of the

nest, where they are very conspicuous. An account of this insect may be found in Bulletin 139, and in the Report of this Station for 1902, page 139.

The forest tent caterpillar, *M. disstria*, was twice received from Hartford. This species makes no tent, but the caterpillars feed singly, often clustering on the trunks of trees when fullgrown and ready to pupate. The forest tent caterpillar has a decided though peculiar blue tint, and instead of a continuous white dorsal line, a row of keyhole-shaped white spots along the back.

Woolly Pine Aphids, *Chermes pinicorticis* Fitch and *Chermes pinifoliae* Fitch. Frequently pine trees growing in woodlands or in ornamental plantings in parks and private grounds are infested by this insect, which forms upon the smooth bark white cottony or woolly patches. If we examine the flocculent matter, we find it made up of small brown plant lice or aphids, each bearing a large number of wax filaments or threads, thus giving it the cottony appearance. This insect is usually found on the shaded trunk of the tree, sometimes nearly covering it and again only in small patches. This is called the woolly pine bark aphid, *C. pinicorticis*.

Another and larger species, *C. pinifoliae*, known as the woolly pine-leaf aphid or pine-leaf Chermes, occurs on the leaves, the young settling around the whorls of branches and feeding especially on the new and tender growth. Though no careful study of these insects has been made in Connecticut, it is certain that both species occur here, and probably often on the same trees.

An infestation of one and possibly of both forms together, occurred in the white pine plantation of the Middletown Water Company in Middlefield. In response to inquiries, we advised that the trees be sprayed with kerosene emulsion. A visit to the plantation was made June 22d, 1911. Men were then spraying, and had already treated about 7,000 trees out of 38,000 planted there. The others were sprayed later. The trees were set in 1904, and though a few trees here and there had died from root injury, most of them had made a good growth.

The kerosene emulsion spray was successful in killing the woolly aphids, as the white patches disappeared and there was only an occasional slight injury to the leaves of the trees.

The Woolly Apple Aphid. The woolly apple aphid, *Schizoneura lanigera* Hausm., causes some injury to apple trees in Connecticut,

though undoubtedly it is a much more serious pest in territory further south and west. Specimens were received in 1911 from Seymour, West Haven, Clinton and Putnam. Occasionally in the nursery a tree is seen with the insects on trunk or lower branches, and often the characteristic bluish white woolly or cotton appearance is noticed on large trees, especially in wounds or cankered areas which are prevented from healing because the aphids cluster there and suck out the sap for their food. On small branches an irregular knotty formation usually results from the attacks of the aerial form, and the root form causes similar irregular swellings upon the roots. This is thought to be due to the poisoning of the parts attacked.

The root form survives the winter, and the aphids migrate in spring to the trunk and branches. In late fall a generation of winged aphids appears, and these migrate and lay eggs in the crevices of the bark, thus starting new colonies.

The aerial form may be easily destroyed by spraying with kerosene emulsion, soap and water, or miscible oil. The root form may be eradicated by the use of carbon disulphide in the soil, and the free use of powdered tobacco has been tested with satisfactory results. In setting new orchards in a section where the woolly aphid causes much damage, it is advisable to mix the tobacco dust with the soil placed about the roots.

The Elm Scale. *Gossyparia spuria* Modeer. This scale insect was sent from New Haven, Yalesville, and Toronto, Canada, during June. This is one of the soft scales, having no shell or armor, and is dark brown with a marginal fringe of white wax resembling cotton or wool. The insect is oval in shape, about an eighth of an inch long, and has a tendency to locate in the cracks and crevices between the plates of bark, especially on young trees. It feeds by sucking out the sap. It sometimes attacks and kills the lower branches of medium-sized trees. There is but one generation each year, and the young are born alive about the middle of June. At first they settle along the veins on the under sides of the leaves but later return to the branches. Honeydew is freely exuded and drips upon the ground. A spray of kerosene emulsion or of common soap and water (1 lb. in 8 gallons) applied at any time of the year will kill this insect. An illustration showing the appearance of the elm scale may be found in the Report of this Station for 1905, Plate III, c.

The Woolly Maple Leaf Scale. The woolly maple leaf scale, *Phenacoccus acericola* King (see Report for 1905, p. 226 and Plate VII), is rapidly increasing as a pest of sugar maples, in the cities and villages of Connecticut. Samples of this sucking insect were received twice each from Bridgeport, Danbury and Ansonia, and once each from New Haven, Middletown and Greenwich, between July 12th and October 16th. Many trees seriously infested have been observed in New Haven, Hartford, Wallingford and other places, and Mr. G. A. Cromie, superintendent of trees in the city of New Haven, states that over fifty infested trees needed spraying this winter in New Haven. A forceful stream of water from the hose will dislodge many of the insects from the crevices of the bark in summer, and spraying with ten per cent. miscible oil in winter is recommended by Professor J. B. Smith of New Jersey for the bark form, while the leaf form cannot well be sprayed, but by burning the fallen leaves most of the insects are destroyed. Mr. F. A. Bartlett, however, states that the sugar maple is sometimes damaged by a fifteen per cent. oil application, when other kinds of maples are not injured.

The Locust Borer. The section of a trunk of a black locust tree filled with insect galleries sent to this office in July (see Plate VIII, *e*) showed the work of the larvæ of a beetle known as the locust borer, *Cyllene robinia* Forst. It has been stated that this pest is the greatest obstacle to the cultivation of the locust tree in the Eastern United States.

The eggs are deposited in the crevices of the bark during September. These soon hatch and the young larvæ feed in the inner bark until winter. During the following spring they bore into the heart-wood, and are often numerous enough to completely honeycomb the trunk with their galleries. The fullgrown larva is about three-fourths of an inch in length, somewhat flattened and club-shaped. The larvæ pupate within the galleries during the latter part of July and the beetles emerge early in September. The beetle is about three-fourths of an inch long, dull black in color with transverse yellow markings. The beetles are often abundant during the fall on the flowers of golden-rod, feeding on the pollen. The locust borer does not attack other plants.

As a rule the locust is not of sufficient value to warrant any treatment. Its value as a honey plant has been questioned. Even

though the locust may blossom freely each year, only during an occasional season do the bees appear to obtain much honey from this species.

Where one is especially desirous of saving the trees it has been recommended to coat their trunks late in August with whitewash to which Paris green or lead arsenate has been added. Badly infested trees should be cut out and burned during the winter to destroy the larvæ. Trees only slightly infested could be treated with carbon disulphide during the early summer. A few drops of this liquid should be injected into the opening where there are indications of fresh borings, and the opening closed with moist earth or putty.

B. H. W.

Ortho-Arsenite of Zinc. This arsenical poison is manufactured by an insecticide firm in California to meet the demand for a substitute for lead arsenate, which is supposed to cause arsenical poisoning or injury to trees through the bark, especially in the black alkali sections of the west. The ortho-arsenite of zinc is a white powder containing about 40 per cent. of arsenic oxide, fully twice the amount contained in the average paste lead arsenate, and the cost somewhat less than the latter.

A quantity of the ortho-arsenite of zinc was purchased by Mr. E. M. Ives of Meriden, who sent a small sample to the station. The chemical department tested a portion of this and found it to contain very little soluble arsenic. Several small trees, including apple, peach and plum, were sprayed May 12th with ortho-arsenite of zinc, some at the rate of 3 lbs. in 50 gallons of water and the others at the rate of $1\frac{1}{2}$ lbs.

The trees were examined four days later and no injury to the foliage was observed from either treatment.

Mr. Ives sprayed about 15 bearing apple trees with the material and noticed no injury to the foliage. A second application to the same trees was made seven days after the first, using $\frac{3}{4}$ of a pound of ortho-arsenite of zinc to 50 gallons of water. The foliage was so badly injured that some of the trees dropped many of their leaves. Mr. Ives had been spraying with paste lead arsenate, but stated that this mixture was all drawn from the pump and barrel before putting in the arsenite of zinc.

The manufacturers agreed to send this department some of the material for further tests, but this was not received.

B. H. W.



A portion of the Entomology Exhibit at the Fairs.





a. Adult of the apple leaf-crumpler *Mineola indiginella* Clem.
Twice natural size.

Connecticut Agricultural Experiment Station

NEW HAVEN, CONN.

SPECIAL BULLETIN



THE BROWN-TAIL MOTH

Euproctia chrysorrhoea, Linn.

(Shown above in all stages twice enlarged)

This insect has sprung into the Northern corner of the state from Massachusetts and Rhode Island and will probably sometime infest the whole state.

DAMAGE. It is a serious pest, the caterpillars feeding upon many different kinds of foliage, but showing a preference for pear, apple, cherry, plum, oak, elm, maple, etc.

It is annoying to human beings because the hairs of the caterpillars which break off and blow about in the air, come in contact with the human skin causing an intense itching and rash, very serious with some persons.

LIFE CYCLE. The eggs are laid in masses containing from 200 to 400 eggs each, on a leaf in July. From 15 to 20 days are required for hatching. The young caterpillars feed upon the leaves until September when they draw together a number of leaves and with the silk which they spin, make a nest in which they spend the winter. In the spring they devour the new foliage and become full grown about the 20th of June. The cocoons are then formed in the folded leaves and two weeks later the adult moths appear. Both sexes are white with brown at the end of the abdomen, and fly at night.

REMEDIES. Cutting off and burning the nests in winter, trapping the adults at electric lights in July, and spraying the foliage with lead arsenate, 3 to 5 lbs. in 50 gallons of water, are the best remedies.

CAUTION. It is a violation of the law to transport living specimens. Chap. 114, sec. 3, Public Acts of 1907. Persons desiring information regarding any insect suspected to be the brown-tail moth should first kill the specimens by dropping them into alcohol or kerosene and then send them to

W. E. BRITTON, State Entomologist

Agricultural Experiment Station

New Haven, Conn.

b. Fac simile of the brown-tail moth placard.

APPLE LEAF CRUMPLER AND BROWN-TAIL MOTH.

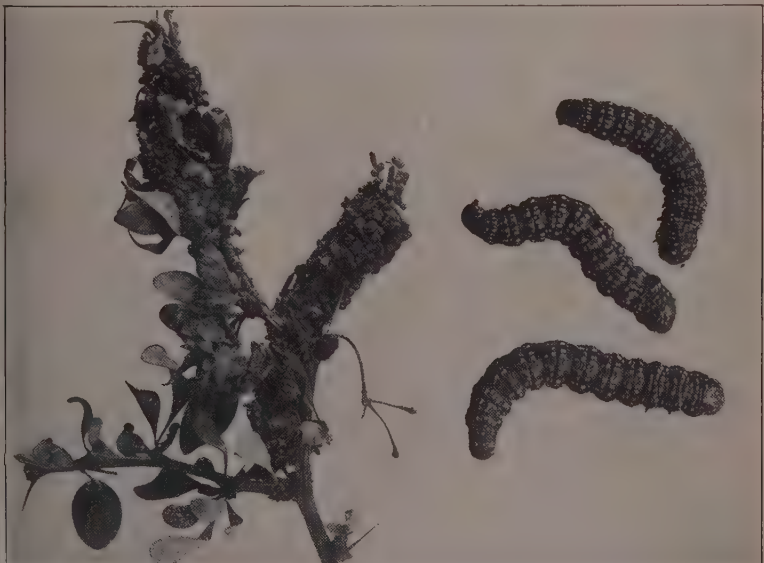




a. Adults nearly twice enlarged; male at left.

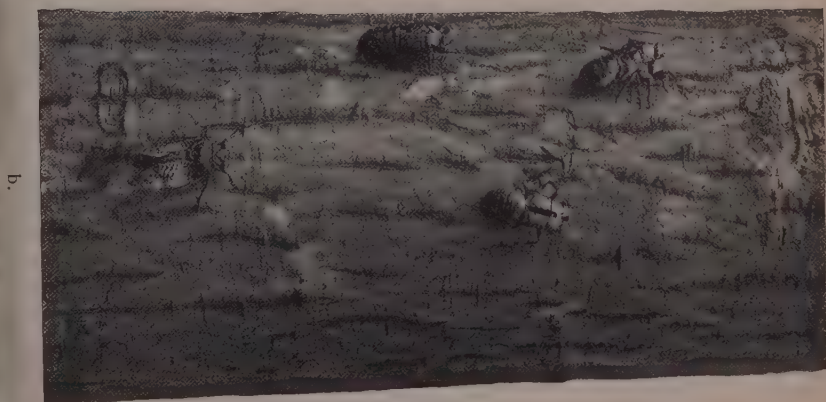
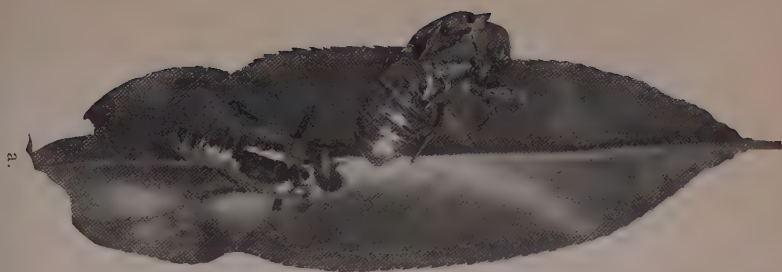


b. Larva dorsal and lateral views, about twice enlarged; front view of head at left, greatly enlarged.



c. Nest at left natural size, larvæ at right twice enlarged.

Omphalocera dentosa Gr. A PEST OF BARBERRY HEDGES.







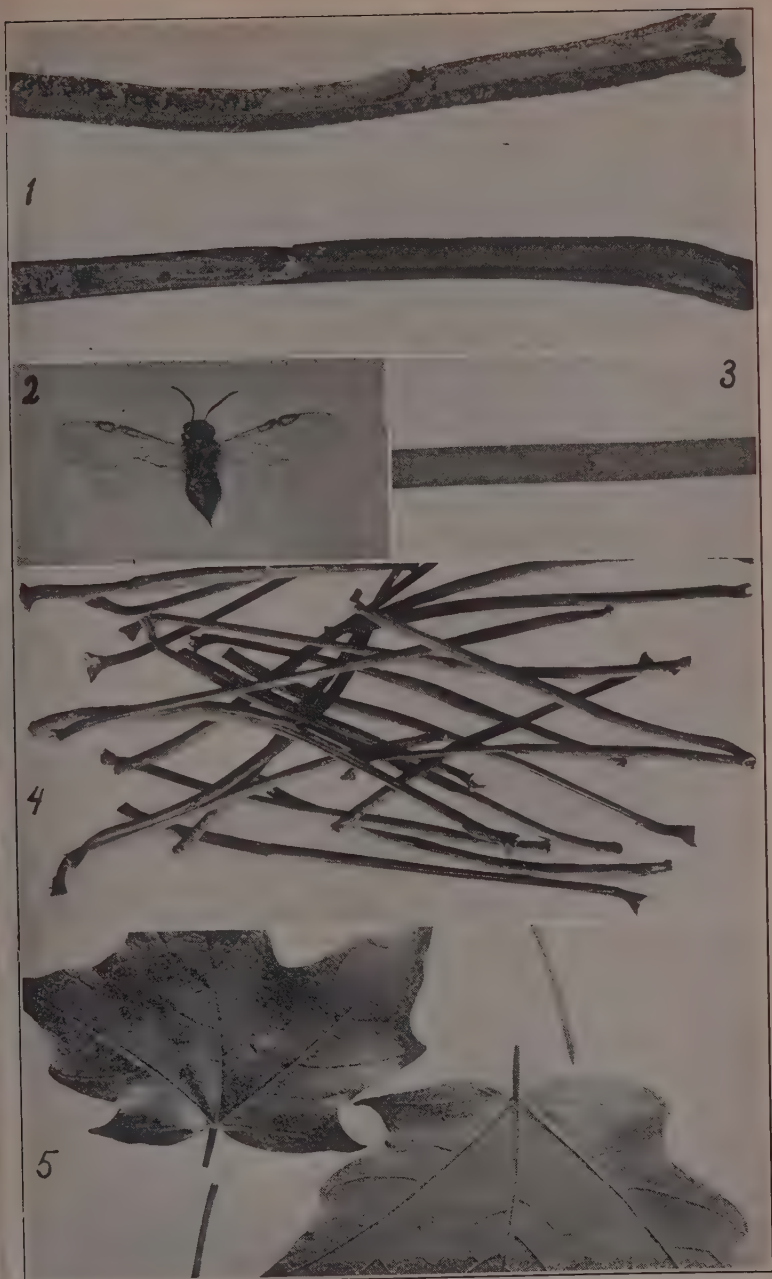
a. Males (below) and females (above). Natural size.



b. Twigs mutilated by the females in laying eggs.

THE PERIODICAL CICADA.

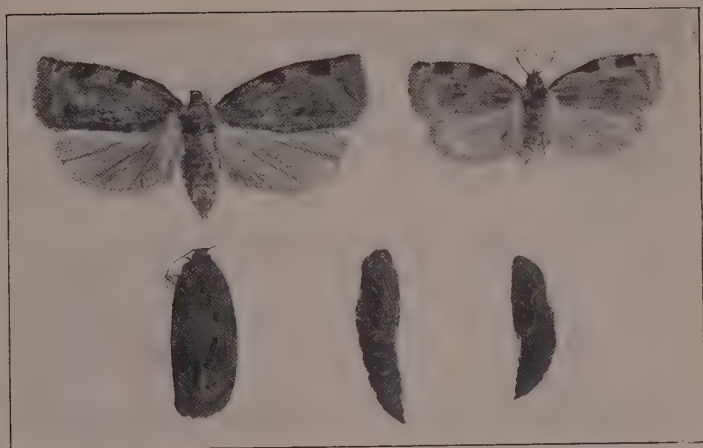




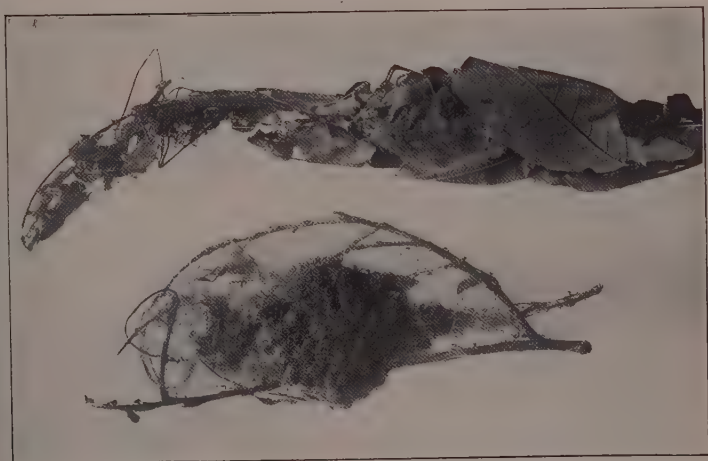
1, larva in stem ; 2, adult female ; 3, exit hole of larva in stem ; 4, stems which have been severed ; 5, leaves with severed stems.

THE MAPLE LEAF-STEM BORER AND ITS WORK.





a. Pupæ and adults. Twice enlarged.



b. Nests or tents. Much reduced.

THE CHERRY TENT-MAKER.





a. The poplar tent-maker, larva, pupa and adults.



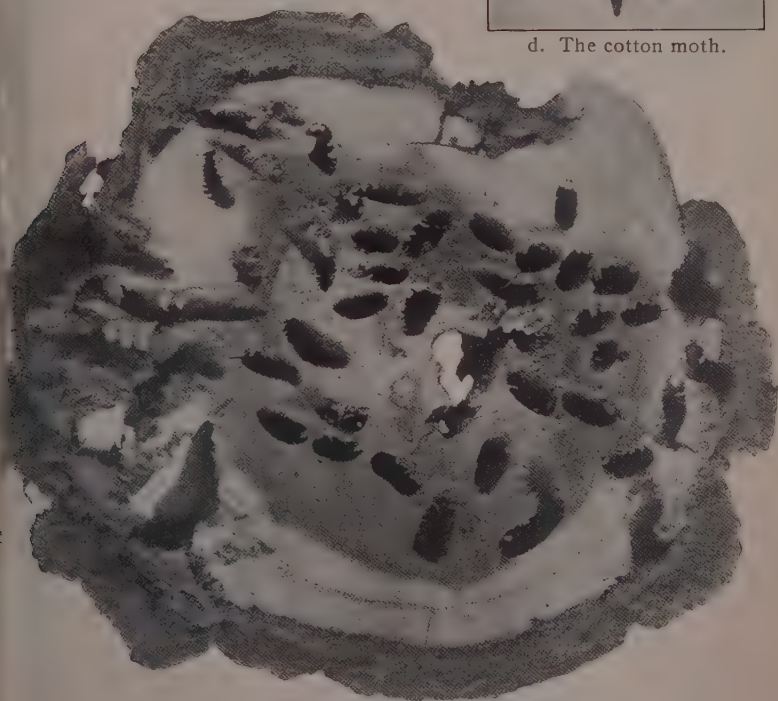
b. Parasitized cocoon of imperial moth.



c. The onion fly, twice enlarged.



d. The cotton moth.



e. Cross section of locust tree showing injury by locust borer.

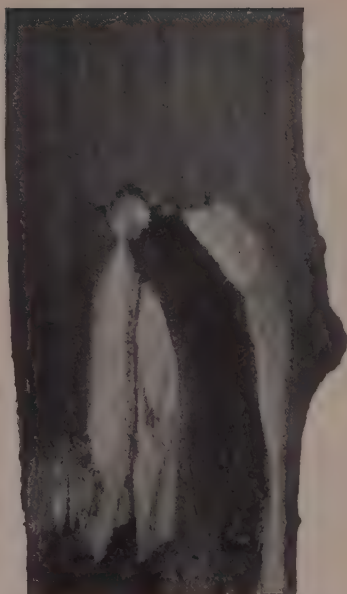
MISCELLANEOUS INSECTS. All except c natural size.



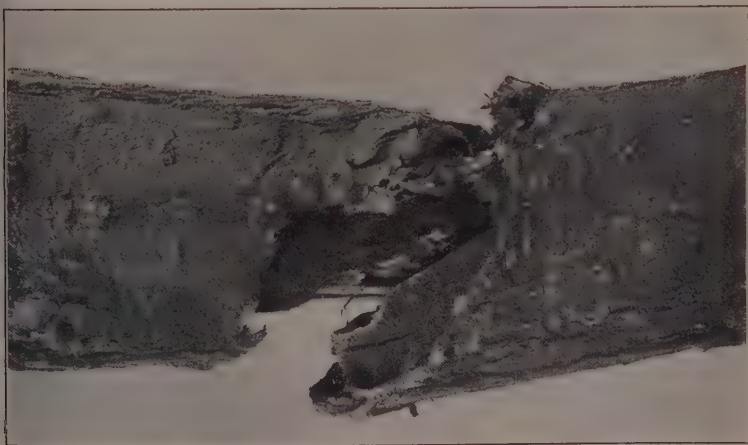
Trees injured by leopard moth show dead terminal branches. View on New Haven Green. Photo. loaned by Geo. Dudley Seymour.

WORK OF LEOPARD MOTH.





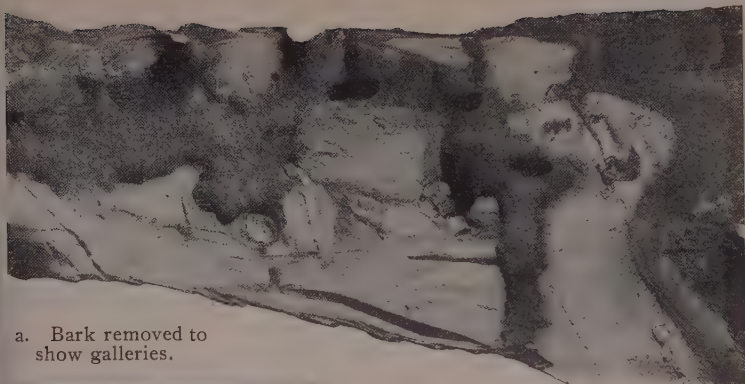
a. White web closing outlet; wood cut away to show burrow. Twice natural size.



b. Branch girdled and broken.

LEOPARD MOTH BURROWS.





a. Bark removed to show galleries.



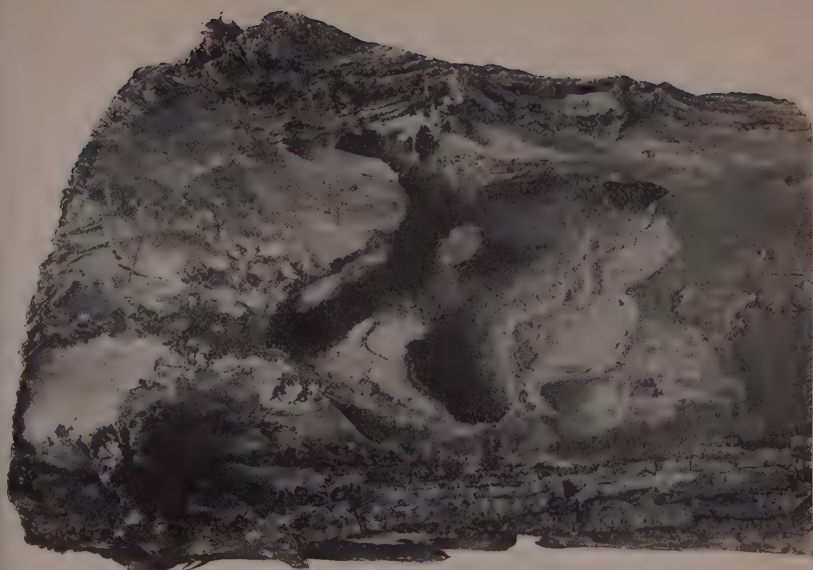
b. Wound on maple trunk beginning to heal. Pupa case above.



c. Winter resting place of larva. Natural size.

LEOPARD MOTH GALLERIES.





a. Elm branch showing galleries of the leopard moth larva.



b. Elm branch girdled by larva and broken.

LEOPARD MOTH INJURY.

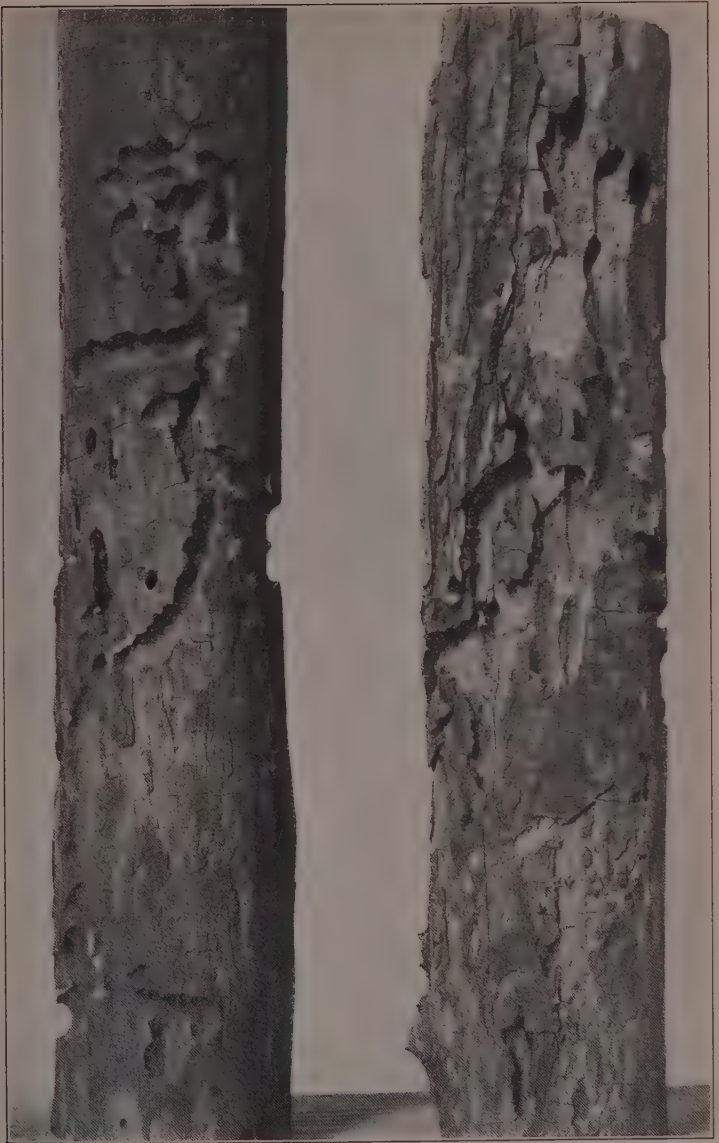




Appearance of galleries in large branches.

ELM BRANCHES GIRDLED BY LEOPARD MOTH.





Dead branches with bark removed to show galleries. "

ELM BRANCHES KILLED BY LEOPARD MOTHS.





Male leopard moth reared from apple nursery stock.

LEOPARD MOTH, JUST EMERGED.





a. Adult leopard moths, female at left. Natural size.



b. Eggs, greatly enlarged.
photo. loaned by J. W. Chapman.



c. Larva in its burrow. Natural size.

EGGS, LARVA AND ADULTS OF LEOPARD MOTH.



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